Digitized by the Internet Archive
in 2008 with funding from
Microsoft Corporation

http://www.archive.org/details/canadianmachv14n04torouoft

CIRCULATES IN EVERY PROVINCE IN CANADA.

CANADIAN MACHINERY AND MANUFACTURING NEWS

A weekly newspaper devoted to the manufacturing interests, covering in a practical manner the mechanical, power, foundry and allied fields. Published by the MacLean Publishing Company, Limited, Toronto, Montreal, Winnipeg and London, Eng.

Vol. XIV | Publication Office: Toronto, July 22, 1915 | No. 4

Librarian
Univ. of Toronto,
Engi. Bldg. Rec. of
A- Sc & E Toro

POSTAGE PAID TORONTO ONT.

LIBRARY
JUN 24 1922
UNIVERSITY OF TORONTO

LACKAWANNA

Steel Bars for Shrapnel
and High Explosives

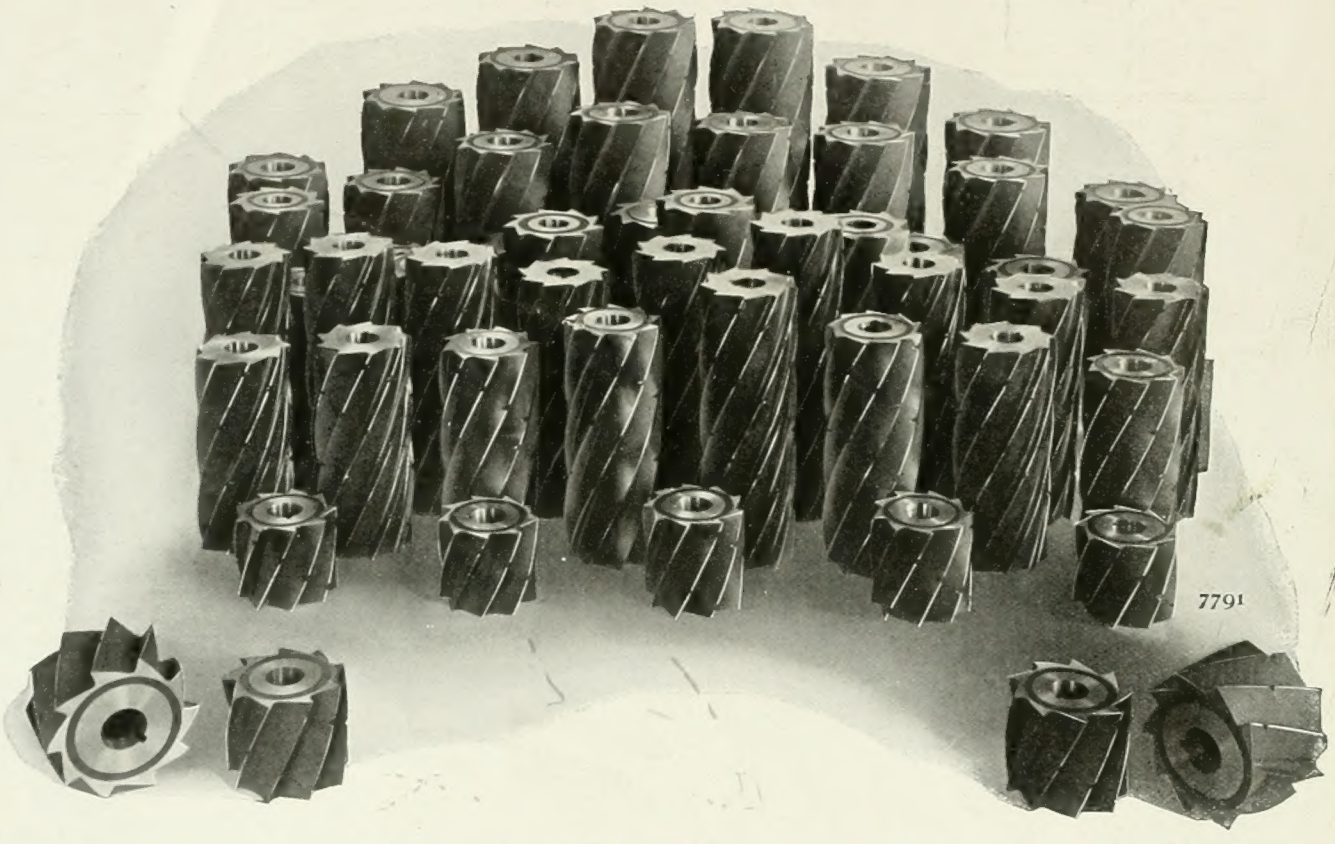
SaBeN ExTrA
HIGH SPEED STEEL

SABEN

The most economical and efficient steel for machining shells, manufactured by Sanderson Bros. and Newbould Limited, Sheffield, England.

H. A. Drury Company,
Limited
MONTREAL and TORONTO

The Solution of Your Heavy Duty Cutter Problem



Use P. & W. Coarse-Tooth High-Speed Milling Cutters

We are prepared to furnish promptly coarse-tooth milling cutters of High Speed Steel adapted primarily to the heavier class of milling.

Long Life. Such cutters have the advantage of long life as the large teeth permit of more grindings. It will also be seen that less time is required to sharpen.

Increased Production. The ample chip room insures a remarkably free cutting action and will increase production by a high percentage with less power required to drive.

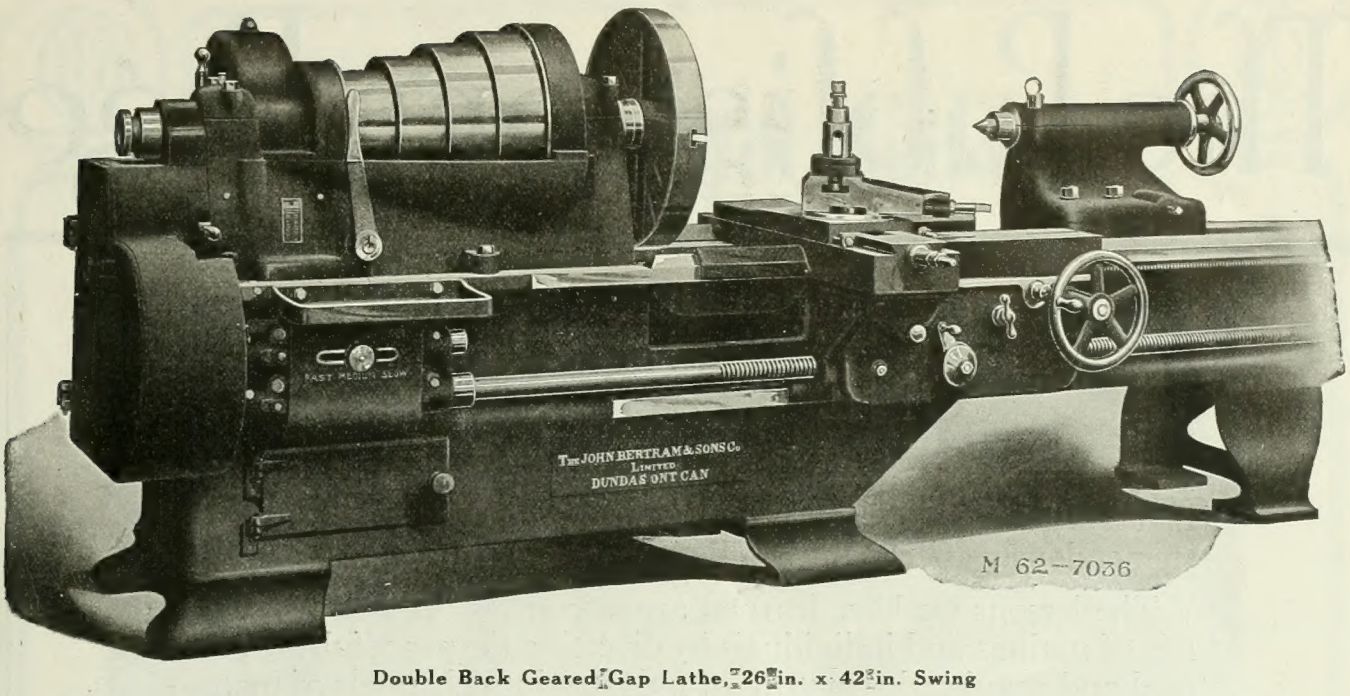
Strong Teeth. The teeth being larger are exceptionally strong and will easily stand the heaviest feeds without breaking.

Place a trial order with our nearest store.

Pratt & Whitney Company of Canada, Limited

DUNDAS	MONTREAL	WINNIPEG	VANCOUVER
Ontario	723 Drummond Bldg.	Bank of Hamilton Bldg.	B.C. Equipment Co.

The advertiser would like to know where you saw his advertisement—tell him.



Double Back Geared Gap Lathe, 26 in. x 42 in. Swing

BERTRAM
MACHINE TOOLS

"THE SURE—SAFE LINE"

Service, simplicity, safety and honest value pervades every

BERTRAM TOOL

Full particulars and photographs ready to be mailed you.

Drop us a card for them.

The John Bertram & Sons Co., Limited

DUNDAS, ONTARIO, CANADA

MONTREAL	VANCOUVER	WINNIPEG
723 Drummond Bldg.	609 Bank of Ottawa Bldg.	1205 McArthur Bldg.

The Publisher's Page

By B.G.N.

ONE YEAR AGO

sane business men and theorists too sniffed at the idea of a conflict that has involved directly half the people of this earth, and has tremendously affected the trading peoples of the other half.

¶ The lessons we have learned are numerous. They affect the life of nations and individuals by diverting the peacefully organized and regulated structure of industry into channels of manufacture that are vieing with each other in the production of engines of destruction.

ONE YEAR HENCE

¶ We hope the *machinery* that has been, *force majeure*, turned and fashioned to military purposes will be converted again to the welcome and more useful paths of peace and progress.

¶ In the meantime the *duty of CANADIAN MACHINERY is to serve the needs of the moment*: To supply the very latest and most accurate information to manufacturers concerning the requirements of those responsible for issuing war contracts.

¶ Every issue of our paper contains *Shell articles of interest* and a fund of information that you need. The advertising pages prove the use of the service that we have developed in our editorial columns. Read them both.

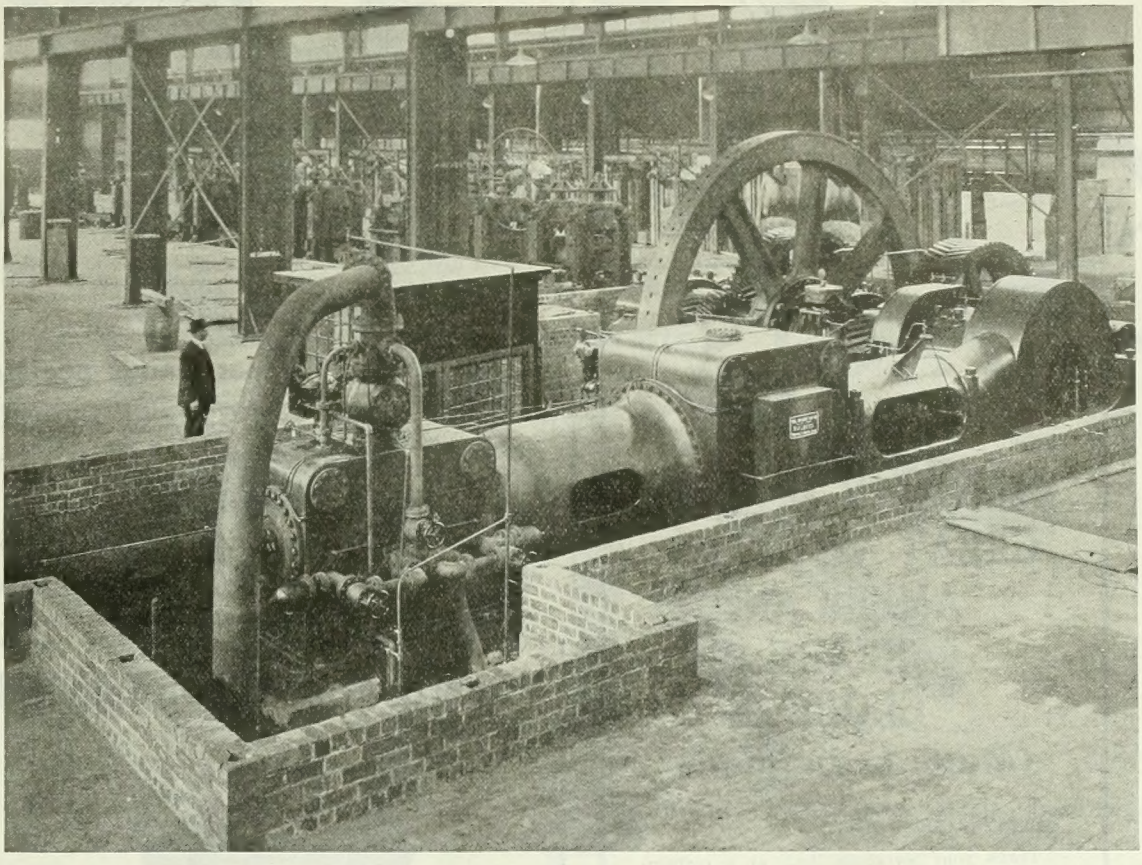
NOW IS THE TIME

for your revived interest. You can intensify it and at the same time strengthen your knowledge. You can, moreover, assemble that knowledge to your own immediate profit.

¶ Rally to the standard of good judgment and recruit your forces by the aid of these columns, editorial and advertising. It is our *"call to arms."* Respond to the call.

CANADIAN MACHINERY
143 UNIVERSITY AVE. TORONTO, ONTARIO

Engine and Mill Builders

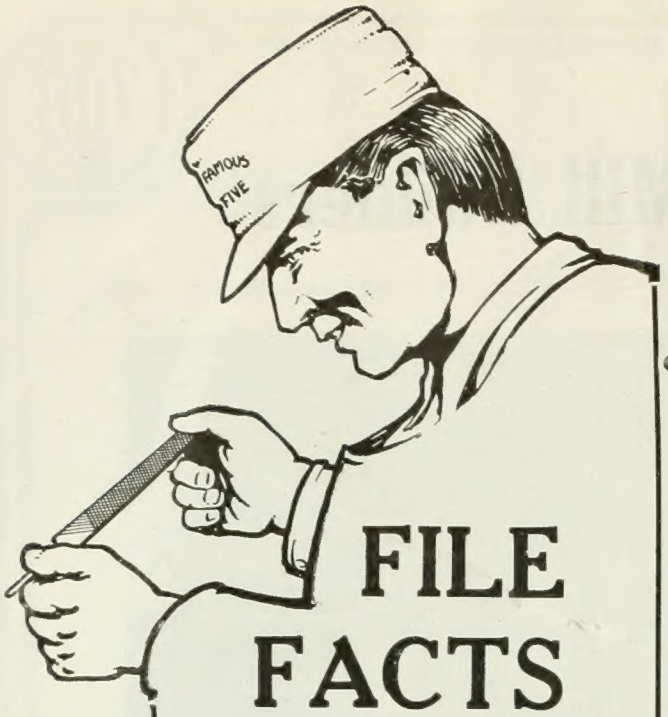


Using a Tod Compound Engine, Helander Condenser and Tod double helical cut gears—such as this installation for the new mill of the Trumbull Steel Company—insures not only efficiency in *generating* power, but also in *transmitting* it to the mill spindles.

The William Tod Company

YOUNGSTOWN, OHIO

ENGINES—Mill, Reversing, Blowing, Gas, Pumping
ROLLING MILLS SPECIAL MACHINERY
HYDRAULIC FORGING PRESSES



FILE FACTS

It isn't enough to merely use the "Famous Five":

KEARNEY & FOOT
GREAT WESTERN
AMERICAN
ARCADE
GLOBE

(Made in Canada)

To get the VERY BEST results—you should use them RIGHT.

Teach your workmen that, at a certain point in its life on any work, a file's BEST efficiency is passed. Beyond that point—continued use means lost time, wasted effort, decreased production and increased cost.

When they understand this fact, they'll discard worn files promptly—as they should. They'll save enough time and labor to pay you a handsome net profit over and above the extra file-cost.

Only by using the "Famous Five" RIGHT do you get the FULL benefit of all we give. The benefit of our 50 years' experience—our five great plants—our special automatic machinery—our complete control of every factory process—our 60,000,000 yearly output—and our record of 90 per cent. of Canada's file-trade.

Each and every one of these advantages should spell MORE NET PROFIT for YOU! Are YOU getting YOUR share? "File Filosophy" shows HOW. Write for FREE copy —NOW.

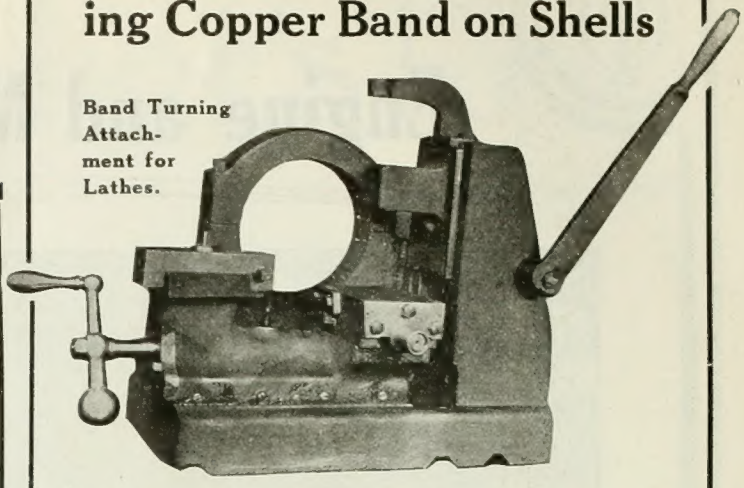
NICHOLSON FILE CO.

PORT HOPE

Dealers Everywhere

A Time-Saver for Turning Copper Band on Shells

Band Turning Attachment for Lathes.



This attachment will fit any engine lathe, and with its use you can turn the copper band on Shrapnel Shells down to size required and burnish them *all in one operation.*

With this device we will guarantee an output of

50 Turned Copper Bands per Hour

Used with a specially constructed steel chuck, casting of which can be finished on the lathe on which the attachment will be used.

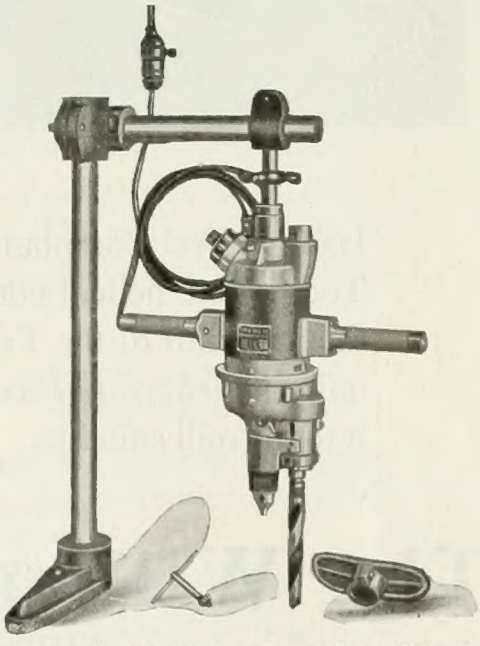
Castings are supplied by us.

WRITE FOR PARTICULARS.

LYMBURNER LIMITED

5-15 Commissioners St. Montreal, P. Que.

Stow Two Speed Two Spindle Drill



The only tool of its kind on the market. Fills a long-felt want. Will cut your cost.

We make drills of every size.

STOW MFG. CO., Binghamton, N.Y., U.S.A.

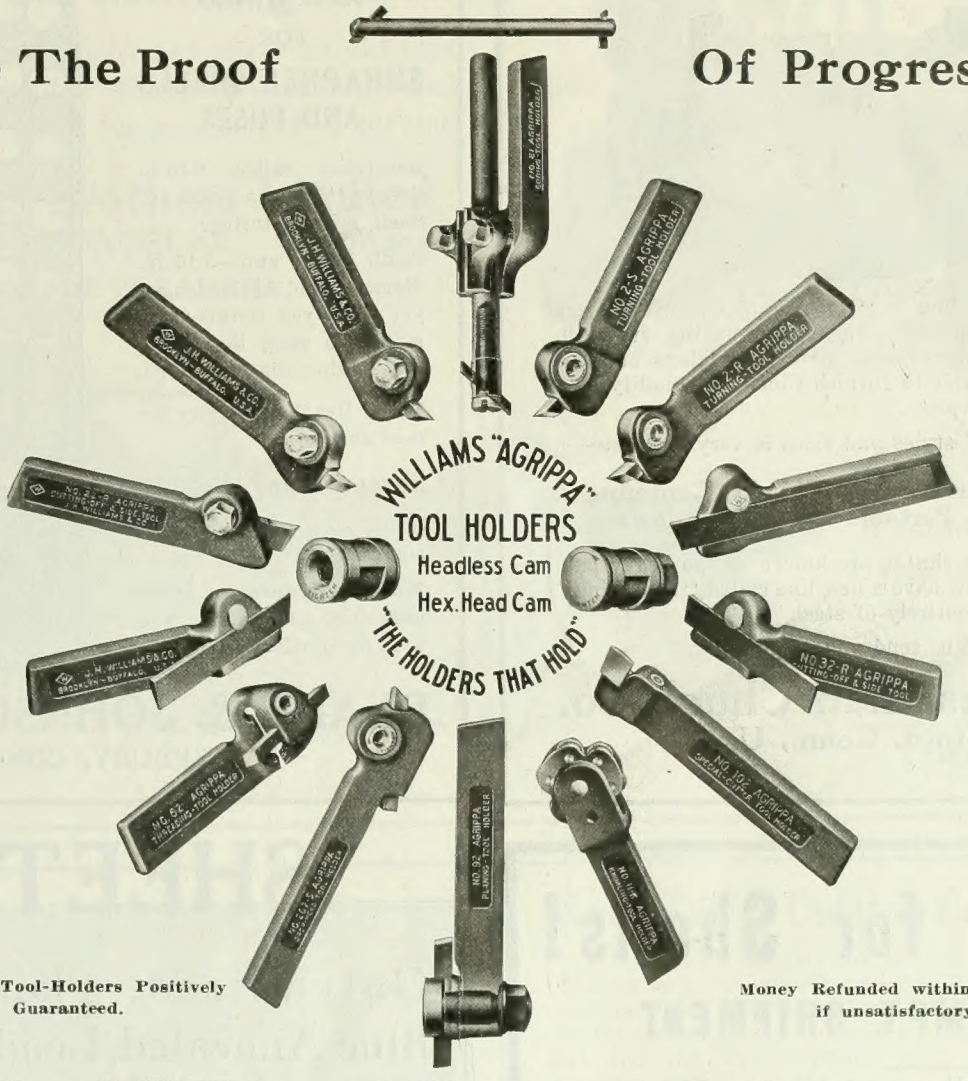
London, England, Stock: 85 Queen Victoria Street

Oldest Portable Tool Manufacturers in America.

The advertiser would like to know where you saw his advertisement—tell him.

Williams' "AGRIPPA" Tool Holders

Are The Proof Of Progress



All our Tool-Holders Positively Guaranteed.

Money Refunded within 90 days if unsatisfactory.

TURNING-TOOL HOLDERS

Cam lock.
Rapid and positive.
The greater the pressure, the tighter the lock.
No set-screws to strip or upset.
No holders to scrap.

CUTTING-OFF & SIDE-TOOL HOLDERS.

Cam lock.
Rapid and positive.
The greater the pressure, the tighter the lock.
Interchangeable blades.
One holder for both cutting-off and side-tool work.

BORING-TOOL HOLDERS

Take multiple bars of all commercial shapes.
No bushings required.

SLEEVE BAR

Universal cap for straight or angle cutter.
No loose or extra parts.

PLAIN BAR

Simplicity itself—a solid bar.

THREADING-TOOL HOLDERS

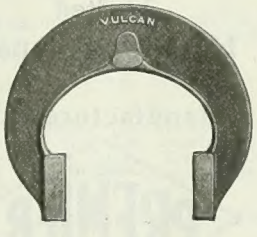
Combination rigid and spring tool for rough or finishing cuts.
Lockable spring head.
Equally efficient for turning-tool work.
Alloy steel cutters.
Cam lock.

PLANING-TOOL HOLDERS

36 angles of adjustment—note serrations in the adjustment ring.
Perfect seating of cutters.
Uniform locking pressure.
Adjustment ring takes the strain, relieving holder of wear.
Excellent also for offset turning-tool work.

Williams' Vulcan Caliper Gauges

For External, Internal and Eternal Use



Capacities 3" to 7½".

Capacities ¼" to 3".

Capacities 1" to 3".

Factories
BROOKLYN
BUFFALO

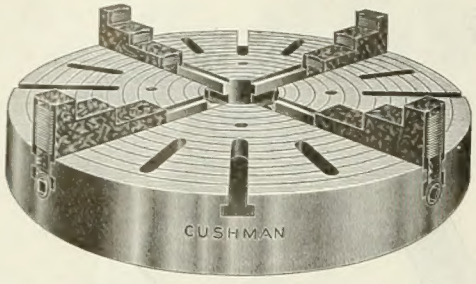
Western Warehouse
40 So. Clinton St.
CHICAGO

J. H. WILLIAMS & CO

43 Richards St., Brooklyn, New York

Exhibitors at PANAMA-PACIFIC EXPOSITION
Block 18, Machinery Building.
Your call will please us.

Cushman Chucks



When you buy a "Cushman" Chuck you are absolutely sure of getting one having strength, accuracy and durability. Being specialists in these goods we are able to furnish Chucks of quality at a very moderate price.

Our line of styles and sizes is very complete—

Lathe Chucks, Drill Chucks, Centering Chucks, Portable Face Plate Jaws

Our regular chucks are known as the heavy pattern, but we now have a new line called "Blue Line" Chucks, made entirely of steel.

Let us send you our catalog.

The Cushman Chuck Co.
Hartford, Conn., U.S.A.

Headless Screws

ALL KINDS FOR SHRAPNEL SHELLS AND FUSES

sometimes called "Grub Screws," are a part of Shell manufacturing.

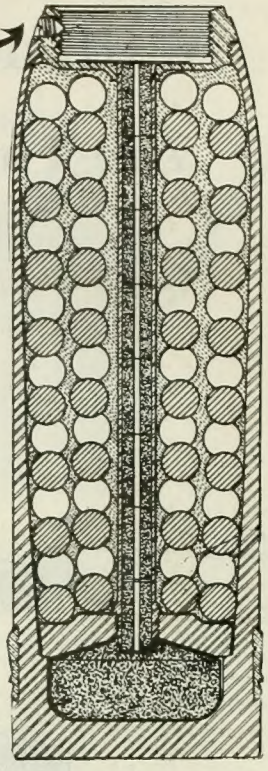
Small in the unit—3-16 in. diameter and ¼ in. long—yet when you consider the multitude used, the aggregate business is very large.

These Headless Screws are used for both

Shrapnel and Lyddite

Shells, sizes to suit requirements.

We have screws for other uses—Let us acquaint you with our product.



BLAKE & JOHNSON CO.
WATERBURY, CONN.

Steel for Shells!

PROMPT SHIPMENT

Billets and rounds of suitable physical and chemical specification for forging and turning into shrapnel cases and lyddite shells of any size.

LACKAWANNA STEEL COMPANY

Standard structural shapes,
Standard heavy and light rails,
Sheared and universal mill plates,
Sheet bars, and Lackawanna
Sheet Steel Piling.

General Sales Offices: LACKAWANNA, ERIE CO., N.Y.

Canadian Correspondents:
H. A. DRURY & CO., LTD., 309 Craig St. W., MONTREAL

SHEETS

Galvanized, Plain Black, Blue Annealed, Lead Coated, Terne Coated, Cold Rolled Strips.

Get our prices on any of the above. We may save you both time and money.

Dominion Sheet Metal Co.
Limited
Hamilton, Canada

Manufacturers of

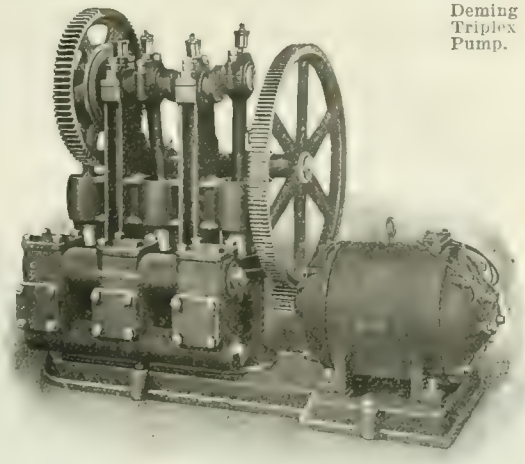
MADE IN PREMIER CANADA

Galvanized Steel Sheets.

35-Q

Are You Making Shells?

Good pumping machinery is essential to the greatest output. We manufacture steam and power pumps for every kind of service.

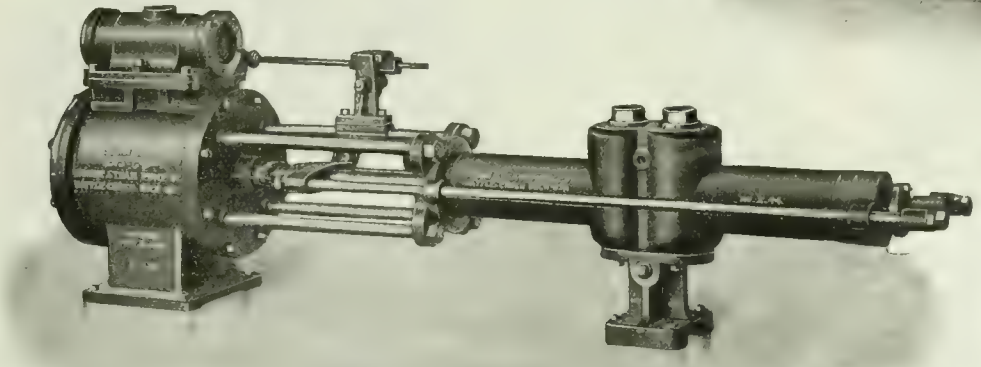


Deming Triplex Pump.

Darling Brothers Limited

Toronto MONTREAL Winnipeg

MADE IN CANADA



Burnham Hydraulic Pump

We are manufacturing special machines used in shell making.

TELL US WHAT YOU NEED.

ECONOMIC WATER OIL

SHELL MANUFACTURERS use ECONOMIC WATER OIL for METAL CUTTING of every description; it will not gum nor rust, and it SAVES TIME AND LABOR.

WE CAN SAVE YOU 50% in the **COST** of your **CUTTING MIXTURE** BECAUSE

ONE GALLON of ECONOMIC WATER OIL will mix readily with **30 to 50** gallons of WATER, making a thick, creamy emulsion, and giving you a cutting mixture which will not only be **satisfactory**, but will produce very **ECONOMIC RESULTS.**

One TRIAL ORDER will **prove** our STATEMENT.

Made in Canada

CANADIAN ECONOMIC LUBRICANT CO.
LIMITED

1040-1042 Durocher St. **MONTREAL**

Keen Kutter Cutting Compound

is a most efficient lubricant for use on lathes, for drilling and cutting. It protects the dies, is very cooling, easily mixed, will not separate, does not injure the hands, and is the best article on the market for the work. Being manufactured in Canada, we are thus able to save the user 20% in price; the quality we guarantee.

QUENCHING OIL

is an oil specially prepared by us for the dipping of shells.

Write us to-day if you are in the market and we will be pleased to submit quotations.

The Commercial Oil Company Limited

Hamilton, Ontario

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Ground to a Perfect Finish in 20 Minutes

The large cast iron rolls, running up to 50 inches in diameter, which constitute an important part of carding machines, are ground with Norton Alundum Wheels in the Saco-Lowell Mills at Newton Upper Falls, Mass. The time: 20 minutes. This is fast time under any conditions—especially so when the necessity for a finished surface that is practically flawless is taken into consideration.

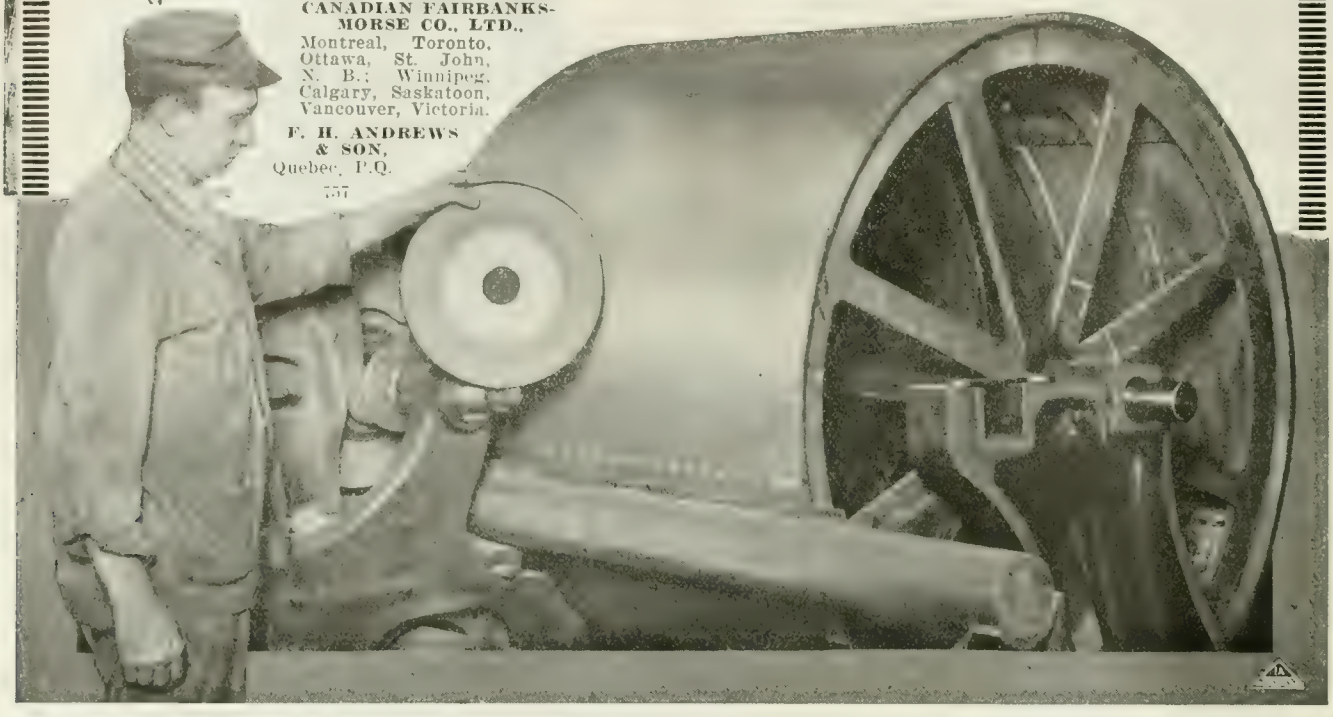
Ask for further facts and figures.

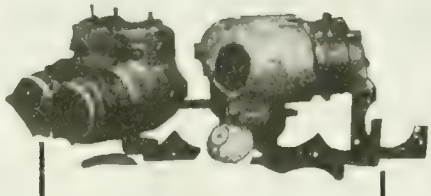
NORTON CO., Worcester, Mass.

Canadian Agents: THE CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal, Toronto, Ottawa, St. John, N. B., Winnipeg, Calgary, Saskatoon, Vancouver, Victoria.

F. H. ANDREWS & SON, Quebec, P.Q.

557

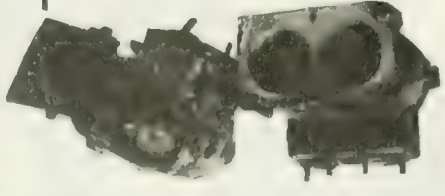




A Total Wreck Salvaged

Hole in Cylinder Head.

Head of Cylinder repaired by Oxy-Blaugas.



Oxy-Blaugas Autogenous Welding and Cutting

LESSENS SCRAPPING OF PARTS. LOWERS MANUFACTURING COSTS AND REPAIR BILLS.

The Oxy-Blaugas Welding and Cutting Process is the safest on the market, extremely simple and may be learned in a few hours by one absolutely without previous experience.

Oxy-Blaugas has enormous heat valve unapproachable by any other industrial gas.

Oxy-Blaugas saves many a tool or machine part from the scrap heap and does away with the necessity of new ones.

Oxy-Blaugas Plant will pay for itself many times over in the course of a year—it embraces many means of aiding your business.

Write for list of its many and varied money saving applications.

Canadian Blaugas Co., Limited

263 St. James St., Montreal, P. Q.

The advertiser would like to know where you saw his advertisement—tell him.

Principles of Design and Lubrication of Bearings

By Frank Foster, M.Sc.

The subject matter of the accompanying article is such as will prove both interesting and instructive to machinery designers and operators. Not a few plain definite statements are made relative to bearing metals and to the means employed to secure efficient lubrication of a journal when carrying its normal load, all of which give food for thought and stimulate a desire to more fully grasp the essentials of these important engineering problems.

DESIGN AND LUBRICATION OF BEARINGS.*

By Frank Foster, M.Sc.

BEARINGS are almost entirely designed according to various empirical rules. Certain general principles based on experimental evidence and reasoning can profitably be associated with these empirical rules, and in some instances current practice may thus be modified with advantage.

Engine lubrication consists in separating two metallic surfaces by means of a film of fluid, usually oil. With perfect lubrication the metallic surfaces do not touch at all, and no wear takes place. Usually, even with the best of lubrication, metallic contact occurs on starting up and sometimes continuously on high spots until these are rubbed down. To avoid spot contract, careful bedding is necessary, especially on large bearings. With imperfect lubrication, such as is usually the result with drip feeds, the oil film is thin and liable to be broken, permitting intermittent or local metallic contact and wear. The laws governing such restricted lubrication are available and differ from those for perfect lubrication. Most empirical bearing rules date back to the days of drip and other forms of imperfect lubrication. Hence it is often possible to revise these old rules, but in doing so the chances of damage are more serious if the full oil supply fails for any reason. For this reason some authorities urge that bearing design should be based on imperfect lubrication, but this is not accepted by designers of turbines and other modern high-speed machinery.

Bearing Load.

The load a bearing can carry when working normally is a matter of viscous hydraulics and not of bearing metals. Bearing metals are important from reasons of manufacture or repair, and in case the lubrication becomes faulty. Lubrication being a matter of hydraulics, correct conceptions of bearing phenomena can best be obtained by thinking of oil as flowing through the extremely shallow, but relatively wide channel between the two bearing surfaces. Looked at from this point of view certain conditions are evident.

1—Oil should be supplied to points at which there is no bearing pressure.

2.—Escape of oil should be prevented except at the proper delivery edge.

3.—The relationships between bearing pressure, speed of flow, thickness of oil film, and viscosity of oil will depend largely on the rate at which the oil is supplied to, and can escape from, the bearing.

4.—The oil film is under the pressure due to the load, and hence the oil must be drawn or forced into the bearing by some means or other.

5.—The physical properties of the bearing metal are relatively unimportant during normal working.

The most important general principle is that stated in (4). With very rare exceptions bearings are their own pumps. The one notable exception is the footstep bearing of the vertical Curtis steam turbine, where the rotor floats on liquid supplied under heavy pressure. In all usual cases of so-called "forced lubrication" the pressure merely ensures that the oil reaches the supply inlet of the bearing. The bearing itself pumps or draws the oil from the supply pressure of a few pounds per square inch to several hundreds.

Bearing Pumping Action.

The natural pumping action of a bearing may be either (or both) of the following kinds:—

1.—The oil adheres to the moving surface, such as the shaft journal, and is dragged into the narrow channel between the (so-called) rubbing surfaces.

2.—The oil is sucked into a portion of the oil channel which is under negative pressure, and upon the reversal of the load is brought under pressure.

Regarding the first of these natural pumping actions, the following considerations apply:—

(a)—The inlet edge of the bearing must be bevelled so as to facilitate intake of oil and not to scrape it off the journal.

(b)—The load the bearing will carry is limited by the outflow or escape of oil previous to reaching the natural delivery edge. This outflow increases with undue clearance, short necks, badly placed oil grooves, low viscosity of oil, and high bearing temperature (this reduces the viscosity), and is very detrimental to good lubrication.

Oil grooves are ill understood and often placed so as to be worse than useless. They have only two proper functions:—To supply oil to suitable local inlets of the bearing and to form closed reservoirs or advanced supply depots, from which more advanced portions of the bearing can be lubricated. All oil grooves should be well chamfered at the delivery, or outflow, edge. This is most important.

Typical Bearing Examples.

A few typical bearing examples will serve to illustrate some of the above points

1.—For a rotating journal under steady load, such as dynamo journals, the oil should be fed to the top or sides where there is no pressure; ring lubrication, therefore, gives good results.

2.—For an oscillating journal under steady pressure, such as the crosshead pin of some single-acting engines, oil should be supplied at the sides, where there is no pressure. Part of the oil dragged in by the journal adheres to the bearing, which passes it on again to the journal higher up on the return oscillation. A closed oil groove (with chamfered edges) parallel to the axis of the journal, and some little distance in from the inlet edge, acts as an advanced supply depot.

3.—Is similar to 2, but with the load alternating in direction; as in the usual crosshead pin. In this case the pin itself pulses fore and aft and acts as a pump plunger. The oil inlet in this case may profitably be in the line of pressure, as it has to feed rapidly during suction; but side feed to the neutral regions is good in many instances.

4.—For a reciprocating bearing under fairly steady pressure, as a crosshead slipper and slide, the inlet to the oil channel between the rubbing surfaces

*From a paper on "Essential Principles of Engine Design" read before the Manchester Association of Engineers.

should be well chamfered, and drip, oil groove, or other feed to intermediate parts of the slide is desirable.

It will be noticed that since the oil is being squeezed out of a bearing, the thickness of the film must decrease from the inlet until near the outlet. In fact, without this, lubrication is very imperfect; and for this reason parallel rubbing surfaces, such as collar thrust bearings, are very difficult to lubricate. By adjusting these rubbing surfaces to give a succession of tapering oil channels with suitable feeding arrangements, this difficulty can be overcome and loads greatly increased without risk. This principle has, in fact, been successfully applied in practice. In the case of ordinary shaft bearings the wedge, or taper formation of the oil channel, is the result of the journal settling itself eccentrically in the bearing.

Professor Alexander deduces from theoretical considerations that the clearances between similar bearing surfaces for machines of the same form and duty should vary as the square root of the journal diameter, or equivalent linear dimension. This is contrary to usual shop rules, but it is interesting to note that practically the same law was worked out from experience and general considerations by the author more than a year ago. This is shown by Table I., showing allowances on diameter in thousandths of an inch for copious lubrication. With drip feeds smaller allowances are desirable.

Table I.—Crankshaft and Crank Pin Journal Allowances.

Diameter, inches					25	20
Proposed allowance					12	11
Theoretical allowance					12.6	11.3
15	12	10	8	5	3	2
10	9	8	7	6	5	4
9.8	8.75	8	7.15	5.65	4.4	3.6

The usual principle adopted in engine design is to allow certain pressures on the various journals. Tables II. and III. give usual practice, pressures being calculated on total piston load without modification for angularity of rod and inertia.

Table II.—Horizontal Engine Bearing

Bearing.	Lbs. per sq. in.
Crosshead pins	1,200—1,300
Crank pins	800— 950
Crankshaft journals (steam load)	100— 150
Crankshaft journals (combined loads)	150— 200
Second motion bearings	100— 200
Crosshead slides	40— 50
Intermediate piston rod slides	20— 40

Inertia should be allowed for in special cases. Journal speeds are rarely taken into account, but there is at present a tendency to do so, especially in Germany. The influence of speed is complex. In many cases it improves the load which can be carried, but it also increases the heat developed per second, and where the pressures are not such as to endanger the oil film, may limit the safe load on the bearing by the tendency towards overheating. For this a rule of the form—

Pressure per square inch × journal speed in feet per second = Constant

is used, but the "constant" varies so widely that its value in the present state of knowledge is limited.

Table III.—Usual Bearing Pressure for Vertical High-Speed Engines.

Bearing.	Lbs. per sq. in.
Main bearings	200—300
Crank pins	400—550
Crosshead pins	1,000—1,200
Crosshead slippers	40—50
Eccentric straps	60—70

Bearing Metal Choice.

The choice of a bearing metal is determined probably more by abnormal working conditions than by normal. When working normally with a plentiful supply of oil the bearing and its journal are not in metallic contact, and the composition of the bearing metal is of practically no moment provided that the steps are sufficiently strong and rigid. On the other hand, the bearing metal becames an important factor in case of failure of the oil supply or overloading of the bearing. Metallic contact then takes place, and considerations of seizing, undue heating and melting out arise. The composition of the bearing metal has also an important bearing on questions of manufacture and repair, especially in the case of large bearings which call for extensive scraping and bedding. The extensive use of white metals is due to their merits under these heads rather than to any particular merits they may have under normal working conditions. In connection with white metals one important point may be mentioned. It is very important to secure close metallic contact between the white metal and the shell of the step so that disintegration is avoided and the heat necessarily generated in the bearing conducted away and radiated without undue temperature rise at the oil film.

HIGH EXPLOSIVE SHELL MANUFACTURE

At a time when high explosive shells are in such enormous demand, we feel says "Herbert's Monthly" that our readers would appreciate an outline of the operation methods which can be employed in making 18-pounder shell bodies, the size which is required in the greatest numbers. The design of these shells is such that the machining is not difficult, and rough material can be used in the form of pieces cut from the bar, which is therefore obtainable by anyone.

The chamber for the explosive being drilled from the solid, either a lathe or drilling machine can be employed for this operation. Further, the outside turning can either be done on engine lathes, or on turret lathes with a roller steady box-tool. It will thus be realised that the number of permutations of the operations by which the machining may be done is very great. We will however, confine ourselves to a description of three typical processes, any of which can be modified in detail according to the plant available. In all cases the material is best used in the form of blanks cut-off from bar, and consequently smaller lathes can be utilised than if the bar had to pass through the spindle.

The blanks can be cut-off on various types of machines, but it is worthy of note that the general practice is to partially cut-off a series of blanks from the bar in order that they can all be inspected and stamped at one time. They can then be broken off and used as required.

If the blanks were completely cut-off, the inspector would have to spend the whole of his time at the cutting-off machine to stamp each blank as it dropped off.

First Method

The first method employs a combination of engine, capstan, and turret lathes. The blanks are first centred at both ends on a centring machine, or sensitive drilling machine, and are then transferred to an engine lathe, where the outside diameter is rough and finish turned as far as the band groove, and the nose profile turned or formed. On being transferred to the next engine lathe, the remainder of the outside diameter is turned, and the large end faced to a definite length.

No. 1 hexagon turret lathes are employed for the next operation, where the shells are chucked nose end outwards, the hole drilled, bored, recessed and tapped. After this operation the shell is adjusted to a definite weight by facing off the closed end, after which it is transferred to a No. 4 capstan lathe, where the chamber for the base plug is bored and chased. The base plug is now inserted, cemented and riveted.

The succeeding operation on the bodies consists of forming the grooves for the copper band, which includes the machining of the waved ribs, and this is done on No. 4 capstan lathes. The chuck carrying the shell is fitted with a double sided former cam, and in the groove a peg fits which actuates the oscillating tool holder carrying the form tool. At the same operation the closed end of the shell is finish-faced. The copper band is next pressed on, and machined on any type of simple lathe with a form tool, a plug being fitted into the open end of the shell.

With regard to the manufacture of the base plugs themselves: these are

made from steel stampings, with either a hexagon or square head stamped on to enable them to be screwed home. A hexagon head is better than a square head, as it enables the stamping to be held in a three-jaw chuck. The actual machining is done on a screw-cutting lathe, fitted with a square turret.

In order to facilitate riveting, a groove is cut near the outside on the unmachined side, so that the edge can easily be turned over.

Second Method

By this method practically the whole of the work is done on capstan and turret lathes. The blanks are chucked in a No. 1 hexagon turret lathe, where they are drilled, bored, recessed, tapped, turned as far as the band groove with a roller steady box-tool, and the nose formed.

At the next operation they are held in a chuck on an engine lathe, the remainder of the outside diameter turned, and the closed end faced to length.

They are then adjusted for weight as previously described, and afterwards the chamber for the base plug is bored and chased on a No. 4 capstan lathe, the succeeding operations being exactly as described in the first method.

Third Method.

This method utilizes a combination of drilling machines, engine lathes and capstan lathes. The blanks are first roughly drilled on a drilling machine, and are afterwards transferred to an engine lathe, where the outside is rough and finish-turned true from the drilled hole, and one end faced. They are then chucked on a No. 1 hexagon turret lathe, where the bore is finished, recessed and tapped, and the nose formed.

The shells are next adjusted for weight, bored for the base plug, and the succeeding operations are the same as the two previous methods.

Use of Automatic Turning Machines.

In the three methods above described, automatic turning machines are not included, but a number of the operations are being performed on this type of machine, with a consequent low rate of labour cost. Both No. 4 and No. 6 automatic turning machines are equally suitable, and the two alternative tool arrangements usually employed are as follows:—

In one case the rough blanks are chucked, and at one setting the hole is drilled and bored, the outside turned as far as the band groove, and the nose formed. In this case, the recessing and tapping of the nose has to be done subsequently as well as the machining of the base plug end and the band groove.

In the second method, the blanks are delivered to the machine with the hole roughly drilled, and the outside rough turned true with the hole. On the automatic turning machine they are then finish bored, finish turned, and the nose formed. In this case also, the thread at the nose end is recessed and tapped subsequently, and the machining of the base plug end done on other machines.

The specifically mentioned machine tools in this article refer, we presume, to the classification adopted by the makers, Alfred Herbert, Ltd., Coventy, England.

BRASS MELTING QUERY.

HAVING seen a few copies of your publication and noticing some questions and answers in same, I am taking the privilege of asking a question re some metal I am having trouble with. This metal (brass) has been put through a fireclay-lined gas retort with a view to obtaining it in large quantities, the composition being: copper 85, lead 10, tin 5. We lose a lot of metal due to its sticking to the lining and also to its coming out mixed with same. Could you suggest a way of getting this metal free of slag or lining? We have put it through crucibles, and some of the metal goes to the bottom all right; still the top of the crucible has a very tough and spongy material, hard to make an opening into to get our melted metal free to pour, and leaving a lot of it still in this mixture. We have a great quantity of this material on hand, and are anxious to get the trouble solved.

We have tried charcoal as a flux, also salt, but get no better results, and were thinking of smelting it same as iron, having rolled a shell 6 ft. long by 30 in., and having brick-lined it. Would you advise this process, and could you give us a dimensioned sketch for its development? We are supplying air by electric fan, and, for air passage around shell, make a recess in the brick lining, so as to not be bothered cleaning out air holes in a circular pipe. These few points are mentioned so that they can be enlarged upon.—Subscriber.

SELECTIVE ASSEMBLY.

WHEN so-called interchangeable work has to be turned out on a large scale as in fuse manufacture, drawings are sometimes dimensioned in such a way that the limits allowed for variations in dimensions cross each other. For example, suppose that a plug having a nominal diameter of 1 in. is to fit into a hole 1 in. nominal diameter, the plug might be dimensioned 0.998 in. high, and 0.994 in. low, whereas the hole might be 0.997 in. low and 1.001 in high. In such a case the high plug would not go into the low hole on account of the limits crossing.

Work produced on this system is not truly interchangeable in the sense that any plug would go into any hole, and it is only possible to assemble such work as "selective assembly," or in the colloquial language of the workshop by "marrying" the parts. Selective assembly or "marrying" is permissible where all the parts are finally brought together in one place in which the final assembling is done, but would be quite inadmissible where spare parts had to be sent to replace any which might wear out, as under such a system there would be no certainty that the spare parts would go into place.

Fuse Manufacture

In fuse manufacture where fuses are finally assembled and examined once and for all, and where the parts do not afterwards need to be replaced, the system is found to be workable and is actually in common use, its advantages being that wider limits of error and therefore easier processes of manufacture are permissible than would be the case where absolute interchangeability is necessary. It will thus be seen that interchangeability in manufacture as commonly understood is of two kinds, viz., the selective and the absolute.

In these days of high-class manufacturing methods and improved processes it is a great question whether selective assembly should not be considered as a survival of old methods and as an unnecessary compromise, as it has been found by some of our best makers of articles produced in quantities, that, by laying out the processes of manufacture in advance under a thoroughly well-considered system, absolute interchangeability is obtainable at no greater cost and with much more satisfactory results than selective interchangeability.

The matter is one which has assumed very great importance recently owing to the fact that so many parts of fuses, shells and various mechanisms which have been required in large quantities for the purpose of the war have been given out for manufacture separately and to different makers all over the Empire, and elsewhere.

In some cases manufacturers of such parts have found that the limits allowed could be decreased with great advantage even from a manufacturing point of view and with the greater certainty that the parts when made would go together and produce the final mechanisms with less trouble at less cost and with better final results than by the selective method.

The matter is one worthy of the most careful attention of manufacturers before beginning to make tools, working gauges, and other appliances necessary for the proper production of repetition work.— Herberts' Monthly.

NEW PROCESS DEVELOPMENTS

Inventive Genius and Research Operate to a Dual End — They Aim to Improve What We Now Possess and Bring to Our Service Commodities Before Unknown

ECONOMY AND EFFICIENCY OF COPPER CYANIDE.*

By C. H. Proctor.

IN the past, copper solutions have been prepared with various materials. The majority of platers used so-called copper carbonate, which is in reality a sub-sulphate of copper, the metal contents of which vary from 45 to 52 per cent. Some platers are still preparing solutions with copper acetate, which tests in the neighborhood of 30 per cent. copper, and others are using cupri-cupro sulphite of copper, which is known in the market as red copper compound, testing about 40 per cent. copper.

Expensive Procedure.

Although the plater knew that of these materials the metal was the only ingredient of value to him, still he was forced to use such impure salts. He, of necessity, had to add about 50 per cent. of inert matter when using the so-called copper carbonate, 60 per cent. when using cupri-cupro sulphite of copper, and 69 per cent. when introducing acetate of copper. You can readily appreciate that, after a few additions of metal salts, the bath became filled with these inert salts and impurities, increasing the density of the bath to such an alarming proportion as to necessitate the dilution of the solution and finally the discarding of the plating bath. The plater realized that this was a most expensive operation, and has therefore looked for a material free from impurities which would make this waste unnecessary.

The silver plating industry first realized the enormity of this waste and silver cyanide has been used in the large silver plating establishments for the past generation or two, having displaced silver chloride and silver nitrate. The platers of copper, brass and bronze who had to deal with base metals have not given this wasteful practice the consideration it deserved, but as the plating of brass and copper is assuming such large proportions, the plater has been forced to give this matter his attention.

Every plater knows that no matter what copper salt is used in a cyanide solution, it must first be converted into a copper cyanide and then cut down with sodium cyanide to form the double sodium copper cyanide. He has endeavored to secure a chemically pure copper cyanide, as with such a material he would introduce into his bath only the active ingredients necessary for results, that is, metal and cyanide, and at the same time eliminate one operation—the conversion of the carbonates, etc., into copper cyanide.

Copper Cyanide Not New.

Copper cyanide is nothing new. It has been available for years, but unfortunately it could only be obtained at a price which made its use prohibitive. The plater has had to continue the use of impure salts. He has had to continue clogging up his solutions with dead salts, which, while they gave results for the time being, forced him to discard, or at least partially discard, the baths when they became too dense. Every plater knows that a dense solution is harder to manipulate and control, and that it requires more current to get a satisfactory deposit. He has had to contend with an unknown factor, the nature of which he had no way of determining. Recently, however, copper cyanide has been put on the market at a price which not only makes its use possible, but which actually results in a decided saving in chemical costs.

Copper Cyanide Chemically Pure.

Chemically pure copper cyanide, testing 70 per cent. copper, the balance of 30 per cent. being pure cyanogen, is now at the disposal of the plater. He knows that with such a chemically pure salt a solution can be made up which will contain only that which is necessary for results, and knowing this, the solution can be controlled with absolute certainty. As the plater is constantly striving to better his conditions and put his plating department on a sounder basis, it will only be a matter of a comparatively short time when this high grade metal salt will entirely displace the copper salts heretofore used in cyanide solutions.

Why should a plater continue using so-called copper carbonate, which contains about 50 per cent. impurities and which must first be converted into a copper cyanide, when he can introduce chemically pure copper cyanide into his bath direct, especially when a solution made up with chemically pure materials can be controlled with absolute certainty? When the bath needs metal, the plater adds it in the form of copper cyanide, and when it requires cyanide, he adds it in the form of sodium cyanide. In other words he is now able to make up a solution which will give the best possible results in the shortest time and remain constant and well balanced.

Chemically Pure Material Solutions.

In the solutions which I will prepare, I will confine myself strictly to chemically pure materials. The copper bath will be prepared as follows:—

Water	5 ounces
Copper cyanide	15 ounces
Zinc cyanide	5 ounces
Sodium cyanide	15 ounces

I will prepare the brass solution according to the following recipe:

Water	5 ounces
Copper cyanide	15 ounces
Zinc cyanide	5 ounces
Sodium cyanide	20 ounces

Of course, by the elimination of the inert salts, the solution will be less dense, the copper solution standing about 3½ deg. Baume. In making up a copper bath I have only used 6 ounces of chemicals per gallon, while to make up a solution of the same metal contents with copper carbonate, I would have to use over 12½ ounces of material per gallon, thus increasing the density over 100 per cent. To make up a copper bath of five gallons to contain the same amount of metal as this solution contains, it would be necessary to use 21 ounces of copper carbonate. To put this in solution so as to obtain sufficient free cyanide for results it would require about 42 ounces of sodium cyanide.

Baume Scale Solution Test.

It is time that the practical electroplater discarded the Baume scale as a test for solutions, as any material that is soluble in water adds to the density of the bath and the Baume scale, therefore, does not give the plater any idea of the condition of his solution. With the constant addition of metal salts which contain large proportions of inert matter, the density will rapidly increase, while the solution may be practically void of metal. The plater must use chemically pure materials or else discard the Baume scale as an index to the condition of his bath.

Relative Cost.

The cost of the copper solution is 12 cents per gallon, while to make up a solution with the same metal content, using so-called copper carbonate, would cost the plater about 25 per cent. more. When we take into consideration that many plants operate thousands of gallons of solution, this economy is a considerable item. On the face of it the metal cyanides appear more expensive. The market price of copper cyanide is from 42 to 45 cents per pound, while the

*From the Bulletin published by Lewis Institute, Chicago.

so-called copper carbonate is quoted at 14 cents per pound.

The plater must not lose track of the fact that copper carbonate or copper cyanide either, for that matter, has absolutely no value as such. It only becomes of value to him when put in solution with cyanide. It is here that the plater saves. He requires only about one-third the quantity of cyanide to put in solution a given amount of copper in the form of copper cyanide as compared with copper carbonate. For instance, the cost of one pound of copper cyanide (70 per cent. metallic copper) put in solution with sufficient free cyanide to obtain an immediate deposit is—

1 lb. copper cyanide, at 42c per lb..	42c
1 lb. sodium cyanide, 29 per cent., at 22c. per lb.	22c
	.64c.

To put in solution the equivalent amount of metal in the form of so-called carbonate of copper, 50 per cent., you require—

1 lb. 6 ozs. copper carbonate at 14c. per lb.	19¼c.
2 lb. 12 ozs. sodium cyanide, 29 per cent., at 22c. per lb.....	60½c
	79¾c

Current Density.

Another factor which must be considered is the current density. It is a well known fact that a dense solution requires a higher electrical pressure, as the inert matter from the metal salts acts as a retarding agent. Of course, the rapidity of the deposit is governed by the ampere law, which teaches us that the more amperes which can be carried upon a given surface the more rapid will be the deposit. The inert matter being eliminated by the use of the metal cyanides, the plater is able to increase the amperage about 25 per cent., and this enables him to reduce the time necessary for results, increasing the output accordingly. He, therefore, is able to turn out more work in a given time without increasing his tank area, which is another decided economy.

Neither copper carbonate nor copper cyanide as a single factor must be taken then as a basis of calculating their relative costs in the plating solution, but when we take the solution complete, ready for operation, as a basis, there can be no doubt that with chemically pure materials the plater not only obtains a solution of maximum efficiency, but is able to materially reduce the plating costs. Once this fact is brought home, it will be a comparatively short time when chemically pure metal cyanides will entirely displace the materials of doubtful purity formerly used.

Standard Solution.

The fact that all copper salts in a cyanide solution must first be changed to a copper cyanide simplifies matters greatly, as copper cyanide can be added to any copper cyanide solution, no matter what salt was originally used to install the bath in question. The plater has obtained results with materials which were at his disposal, but it was always with a degree of uncertainty as to how the bath would behave. This uncertainty is entirely removed once a plating solution is standardized, and this ideal condition can only be reached with the use of metal salts which are correct from a theoretical and practical standpoint, and it cannot be disputed that the only metal salts which answer these purposes are the metal cyanides.

WELDING UP SCRAP NICKEL ANODES.

SOME important experiments in the welding of nickel anodes by the oxy-acetylene process have just been concluded in the plating department of The Prest-O-Lite Co., Inc., at its Indianapolis plant. As a result of these experiments and tests, worn nickel anodes which have previously been scrapped and sold at less than half-price are now being reclaimed at a saving of more than 100 per cent.

WELDED-UP SCRAP NICKEL ANODES.

The anodes used are castings of 90 per cent. nickel, 8 per cent. carbon and 2 per cent. iron. They are elliptical bars approximately 1½ in. by 3½ in. cross section, by 30 in. long, and weigh about 30 lbs. Their market value varies between 46c and 50c per lb. On the basis of the latter price, each 30 lb. anode has a value of $15.

By welding up old anodes which have been in the solution, and which have a junk value of between 22c and 25c per lb., this concern is now converting its entire pile of scrap nickel into what are practically new anodes at a total cost for gas and labor of less than 6 cents per lb. This estimate is based on a recent test at Indianapolis, in which 421 lbs. of scrap anodes were welded up at the following costs:

463 cu. ft. oxygen, at 2c.....	$9.26
480 cu. ft. acetylene, at 2c....	9.60
24 hours' labor, at 25c.....	6.00
Total	$24.86

In view of the fact that this test was made before any experience in the operation had been gained, it is apparent that better results and greater savings are sure to be the result of practice. The method of handling this operation is about as follows:—

Operation Features.

As the anodes are eaten away by the solution, they are turned over to an oxy-acetylene welder, who "tacks" on scraps of old anodes by welding to increase the surface. One, two, three and sometimes four pieces of scrap are welded on, depending on the size and weight desired.

The welding flame is also employed to remove the brass hooks which are used to support the anodes while in solution. Under the intense heat of the oxy-acetylene flame (approximately 6,300° F.) the solder melts away rapidly, leaving a pure nickel bar, which is later welded up. Thus, by the addition of from, say, 5 to 15 lbs. or more of scrap nickel, a brand new anode, it is claimed, is manufactured at trifling cost, and every bit of scrap is utilized without the loss of a single pound of metal.

No flux is employed, as this has been found to be unnecessary. The pieces of scrap are simply melted-on or "fused" together, using another piece of nickel as a filling rod. The welding process is of great benefit in obtaining perfect fusion, which is essential, as all joints must have electrical conductivity equal to that of new anodes.

Another advantage is that no skill or experience in the art of oxy-acetylene welding is required to weld up scrap nickel anodes—in fact, any workman with average intelligence can do the work without previous knowledge of the process. The apparatus required to do the work is inexpensive.

Many previous attempts have been made to utilize scrap nickel anodes, the most common practice being to drill holes through several pieces and bind them together by means of lead rivets. This method depends upon the contact of the wire or rivet and the piece of scrap to conduct the current, and is, therefore, of uncertain value, and in many cases a flat failure.

PRODUCTION METHODS AND DEVICES

A Department for the Interchange and Distribution of Shop and Office Data and Ideas Evolved from Actual Practical Application and Experience

JOBBING PULLEY PRACTICE.

By J. H. Eastham.

WHILE ordinary pulley moulding is so simple as to call for no special explanation, circumstances occasionally arise in millwright and repair shops that require a little study in order to keep cost of production low enough to cope with competitive selling prices. The foundryman owning a set of pulley patterns of loose rim, separate hub and arm types possesses a

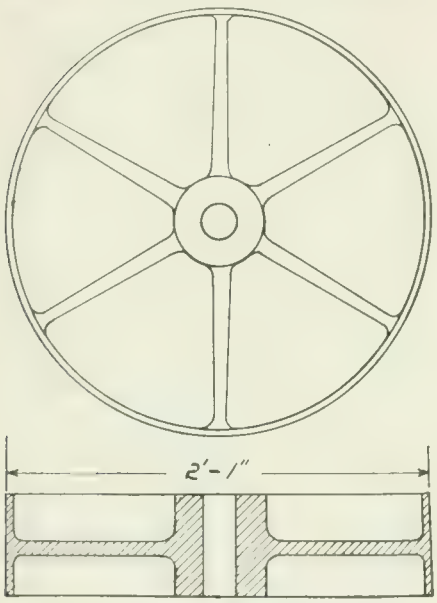


FIG. 1. PULLEY TO BE MOLDED.

valuable asset if he be located in a manufacturing centre, as he is then able to handle rush orders to customer's satisfaction.

The casting 2 ft. 1 in. diameter by 6 in. face, indicated in plan and sectional views of Fig. 1, was ordered to replace

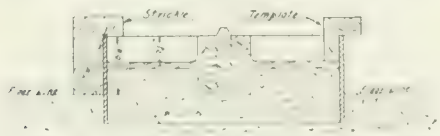


FIG. 2. JOBBING PULLEY PRACTICE.

a breakdown at short notice. The order was received at ten a.m., and was accompanied with the request that the finished pulley be shipped not later than the evening of the following day. The pattern, nearest to size of casting required, measured 2 ft. 4⅝ in. outside diameter, by 10 in. deep, and was used regularly for the production of 24 in. diameter pulleys. The method of molding employed was as follows:

The rim pattern was bedded into the foundry floor to a depth of four inches, dead level (a most important factor in large pulley moulding), the correct depth

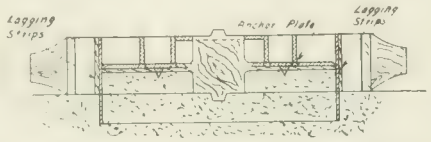


FIG. 3. JOBBING PULLEY PRACTICE.

being gauged by means of the strickle shown to left of sketch in Fig. 2. Following this operation, the inside of the rim was rammed up to within six inches of the upper edge, the arms and lower half of hub being next bedded to place correctly by using the small L shaped template shown to right of the same drawing.

A cheek or midpart approximately 2 ft. 8 in. square by 6¼ in. deep was now placed on the parting left by the strickle above mentioned, and an anchor plate used regularly for the production of 2 ft. 0 in. pulleys lowered on the parting between the arms. Lagging strips 6¼

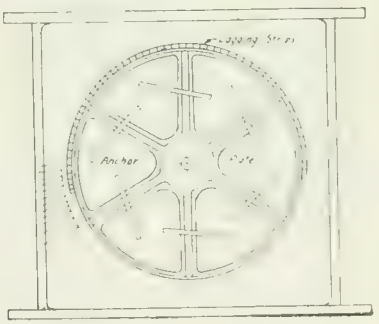


FIG. 4. JOBBING PULLEY PRACTICE.

in. deep by 1¼ in. wide and ½ in. thick were next placed around the outside circumference of the rim pattern to bring up to required diameter, plus contraction and machining allowances; the mould at this stage being shown in plan and cross section by Figs. 3 and 4 respectively.

The cheek and anchor plate were next rammed up to lip of rim in the ordinary way, the upper parting made, the cope rammed up, and guide stakes driven in

FIG. 5. ANCHOR PLATE ON BOARD.

handle corners. Following this the cope was lifted off and the rim pattern drawn.

The anchor plate with upper half of hub was next removed, the hub pattern drawn downwards, and the plate placed temporarily on a board as indicated at Fig. 5. The cheek was then lifted off, arms and lower half of hub drawn out and finished, and the lower four inches of rim filled in with sand to lower parting level. This operation is shown partly completed at Fig. 6.

The hub core was next placed in position, and the mould closed and made ready for pouring, being so shown in cross section at Fig. 7. With the object of removing surplus weight thrown on the rim owing to the increased diameter, as well as to secure perfect bal-

FIG. 6. JOBBING PULLEY PRACTICE.

ance, a cut was taken off the inside of the pulley whilst machining. The finished casting was delivered several hours ahead of schedule.

SAFETY FIRST — THE SHEET METAL PUNCH PRESS.

By J. H. Rodgers.

ONE of the greatest opportunities for the demonstration of "safety first" is in the protection of the operator on the ordinary sheet metal-working punch press.

A very large percentage of accidents to hands and fingers of men and boys in the metal working industries can be traced back to the stamping press, and in many cases when an accident happens, the operator will say that the press "repeated." This may or may not have

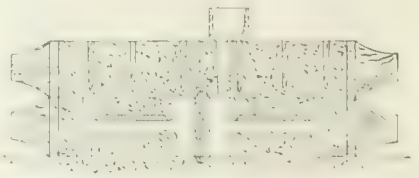


FIG. 7. FINISHED MOLD.

been the case, but, if the press did "repeat," it was due largely, if not entirely, to neglect on the part of the operator in not allowing the latch to engage the clutch pin and thereby release the press.

In the operation of most punch presses the foot is pressed down on a treadle, which pulls the stop latch away from the clutch pin. This clutch pin, by action of a spring, is forced in contact

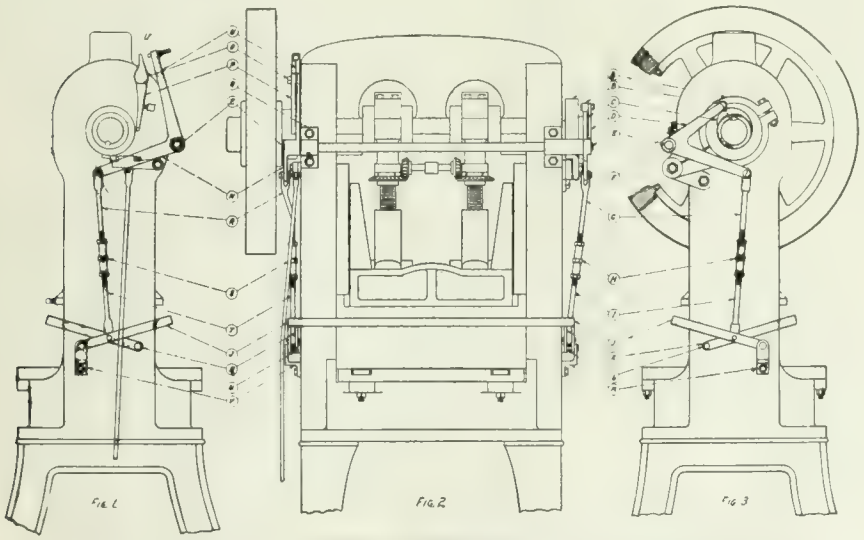
with the clutch which revolves the crank shaft. Removing the foot from the treadle, the latch returns to its former position and engages the clutch pin, thereby releasing the clutch when the shaft has made one revolution.

In many cases the operator, instead of removing his foot, will allow it to return to its former position with the treadle, and it is just at this point that the primary cause of many accidents becomes evident. Many operators, when keeping their foot upon the treadle, do not allow it to raise to its proper position, and instead of the latch engaging with the clutch pin the full amount, in a large number of instances, the contact is scarcely one-sixteenth of an inch.

Now this condition of affairs neither facilitates the operation of the press nor increases the output, while, on the other hand, an opening is left whereby any unforeseen incident, as his chair being jarred, a noise attracting his attention, etc., might cause the attendant to depress his foot before the proper time, and allow the press to operate or "repeat."

Many different styles of guards are now in service to reduce the possibility of accident, and these have had varying degrees of success. To produce a device that will protect (to the maximum) the operator in the performance of his duties, has been for years the desire of many an enterprising mechanic.

The object of this article is to place before the readers of **Canadian Machinery** a safety device for power presses and analogous machines, which has been developed and patented by Wright & Stacey, of Hamilton, Ont., and is manufactured by The Brown, Boggs Co., of that city.



SAFETY DEVICE FOR POWER PRESSES AND ANALAGOUS MACHINES.

Safety Device Features.

The accompanying drawing shows the device applied to a double crank arch press, and protecting both the front and rear of the press. Fig. 1 shows a view from the clutch end of the press; Fig. 2, a rear view; and Fig. 3, a view from the brake end.

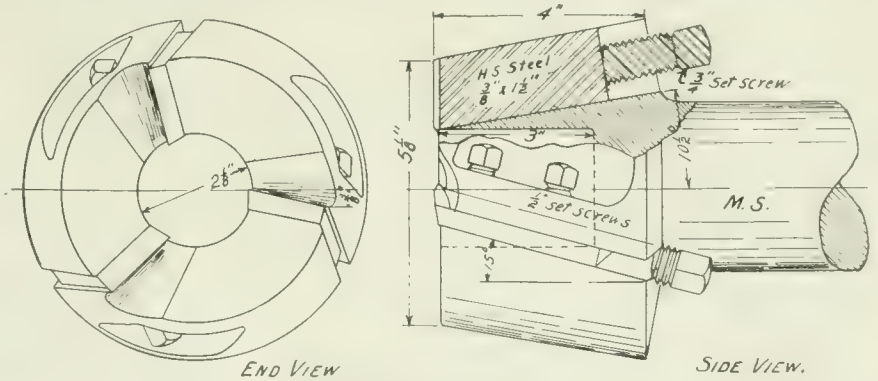
Secured to the brake end of the crank shaft is the cam C, which engages with the roller B carried on the upper arm of the bell crank D, which is secured to one end of the shaft E. Connected to the lower arm of the bell crank D are the rods G and I (adjustable with the right and left hand nut H). Rod I supports one end of the guard bars J and K.

Attached to the opposite end of shaft E is the bell crank N, which supports the other end of the guard bars J and K by means of the rods R and T and the adjusting nut S. The stud O carries the stop dog P, one end of which rests against the clutch hub of the press in such a position as to engage with the clutch pin when the crank shaft has moved through a portion of a revolution.

Operation.

The operation of the mechanism is as follows: The treadle of the press is lowered in the ordinary manner, allowing the ram to descend. Immediately the crank shaft—and also the cam C—revolve, the guard descends. If all is clear, the bars J and K will drop to their extreme position and allow the screw U to come in contact with the upper tail of the stop dog P, at the same time removing the opposite end sufficient to allow the press to complete one operation.

If, on the other hand, the operator's fingers, or hand, or any obstruction prevents the guard bars from reaching the safety position, the screw U does not reach the tail of the stop dog P. The opposite end will then engage with the clutch pin and disengage the clutch, stopping the press.



A 2-INCH HOLLOW MILL

TWO-INCH HOLLOW MILL.

By "Nene."

THE distinguishing feature embodied in the accompanying sketch of a hollow mill is the angle at which the tools are set into the holder. This method gives greater clearance for the cuttings, causing them to curl outwards clear of the work. It also contributes to the free cutting properties.

The body of the tool is of machine steel, the grooves being milled at the desired angle, and not quite equidistant to avoid chattering when in operation. The three inserted cutters are of high-speed steel.

Each cutter is held firmly in position by two ½-inch set-screws and is adjusted to position by the ¾-inch set-screw shown. The holes for these latter screws are drilled and tapped before the cutter slots are milled. The tool was designed for 2-in. work, but a limited adjustment above and below this size is obtained by retarding or advancing the cutters in the slots.

The satisfactory nature of the work done by this tool may be estimated by the fact that locomotive cross-heads and knuckle-pins have been reduced from a diameter of 4½ in. to 2 in. for a length of 1½ in., and threaded in the space of 2½ minutes.

BALL-BEARINGS FOR MILL LINE SHAFTING.

BALL-BEARINGS have now reached such a high level, both as regards design and manufacture, that the thoughtful works manager is asking the ques-

tion as to whether they can help him to overcome the very many troublesome bearing questions which confront him. The surest and safest answer is that given by the history and development of the ball-bearing industry, and is such that any doubt regarding their efficiency and reliability is soon dispelled. The idea of substituting the action of rolling for sliding is as old as anything we know of. The earliest application of this principle we find when heavy structures are moved by using pieces of tree trunk to act as rollers.

Owing to the specialization necessary for cheap production, the average engineer looks upon a ball-bearing as an unknown quantity, which is entirely due to the lack of information. The efficiency of a ball-bearing should not be less than 98 per cent. The co-efficient of friction of 0.0012 relative to the shaft diameter can be compared with the co-efficient of friction when surfaces rub against each other when under load. Should the co-efficient for the ball-bearing be higher than given above, an excessive amount of sliding instead of rolling is taking place, which owing to the smallness of the surfaces in contact would result in wear; therefore, sliding must be avoided. This is where the ball-bearing is superior when compared to the roller bearing, with which sliding always takes place, and thus gives a high co-efficient of friction when compared with a ball-bearing.

Ordinary Bearing Losses.

The efficiency of mill line-shafting on ordinary bearings is variously estimated by different authorities at between 60 to 70 per cent., the lowest value generally being favored. The loss of efficiency is due to the following causes:—

(a)—Power wasted due to sliding friction of the shafting.

(b)—Belt and rope losses, which easily become excessive when the speeds are high for the size of rope or belt adopted, and thus causing undue creeping.

(c)—Power wasted when the shaft is unduly out of line, and at every revolution a certain amount of power is taken in bending it.

Eliminating Friction Losses.

All these evils can be reduced by using ball-bearings.

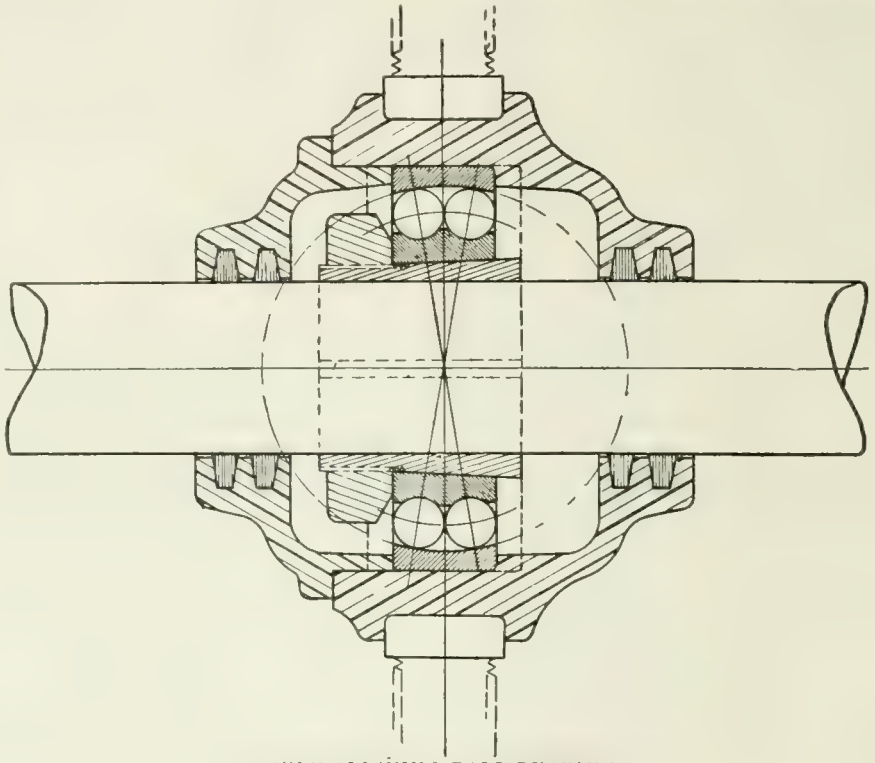
The loss due to friction for all practical purposes ceases to exist by substituting ball-bearings. The efficiency of the line-shaft due to this loss is raised at least 20 per cent., and since no energy is wasted at the bearings, the danger of them running hot is avoided.

Belt and rope losses are reduced by arranging the shafting to run at any speed required, and, mounting on ball-bearings, speeds of from 200 to 600 revs. per minute are not uncommon; the speed depending upon what is required and not upon the limit imposed by the bearings. When the shafting is run at a high speed upon ball-bearings the initial cost is reduced from 20 to 50 per cent. of that for a line-shafting upon plain bearings; this is brought about by using smaller pulleys and shafting for the same belt speed and pull. Besides the saving in power and the initial cost, the smaller dead weight supported by the columns is reduced.

The bending of the shafting can be entirely overcome by using wall brackets or hangers, which permit of easy adjustment. With the increased efficiency of line-shafting upon ball-bearings, a smaller power unit can be used for driving, so that a saving occurs both in the consumption of power and the capital outlay. A return of over 100 per cent. upon the capital outlay of the bearings is the rule; however, when the existing shartings is of larger diameter and has swells, and runs at a comparatively slow speed, the figure is reduced, but it is very seldom below 40 per cent., even in the very worst cases. Ball-bearings only require their housings to be filled with a suitable lubricant two or three times per annum.

Shafting upon ball-bearings is free from wear, which cannot be said of shafting running upon plain bearings, and when the atmosphere is of a gritty nature this wear becomes serious.

The illustration shows design of ball-bearing which has proved successful mounted in a cast-iron housing suitable for holding in a hanger frame. It is self-aligning, the alignment taking place by the frictionless rolling of the balls upon the spherical inner surface of the outer race of the bearing. The nut which forces the inner race of the bearing along the sleeve causing same to contract and grip the shaft, must be screwed up in the opposite direction to that of the rotation of the shaft. The diameter of the screwed plungers must be sufficiently large so as to prevent distortion of the housing. For each independent line of shafting one bearing only must be held sideways in the housing to keep the shaft in position as shown by full lines; all other bearings must be free to move sideways in the housings as shown by dotted lines.—The Power User.



SELF ALIGNING BALL-BEARING

Torpedo Balance Chamber. — The mechanism that determines the depth at which a torpedo runs is regulated first by a swinging pendulum and secondly by a valve kept in place by a spring, but which is forced in by the pressure of the water whenever the topedo sinks lower than a certain depth. The valve can be adjusted to any depth by the spring. Both pendulum and valve are connected to the horizontal rudders outside the torpedo.

Winnipeg, Man.—The contract for putting in the sub-structure for the huge cantilever bridge to be built over the Nelson river at Manitou rapids, for the Hudson Bay Railway has been awarded to Robert McDonald, of Winnipeg.

EDITORIAL CORRESPONDENCE

Embracing the Further Discussion of Previously Published Articles, Inquiries for General Information, Observations and Suggestions. Your Co-operation is Invited

CONCERNING SEMI-STEEL.

By "Melter."

MUCH has been said from time to time concerning the advantages and disadvantages to be derived from the addition of varying proportions of steel to cast iron, and melting in a cupola to produce commercial castings. Whether this can be done beneficially depends on local conditions involving size, shape and requirements of castings. The production of castings, soft or hard, irrespective of size or service conditions are also factors to be considered, although these ultimately resolve themselves into a question of cost. Generally speaking most castings require strength, so we shall consider this variety.

To appreciate why it is practical to use steel in the mixture or otherwise, something must be known of the factors influencing the strength of cast iron and the main differences effected by the use of steel. As the elastic limit is near the point of rupture in cast iron, it is necessary to get an iron having a high ultimate strength. That the elastic limit is near the ultimate strength is demonstrated by the fact that it is impossible to detect any difference other than that the deflection is proportionate to the load until just before failure.

The Strength Feature.

Strength depends on the size and percentage of graphite flakes, percentage of combined carbon, size of crystals of solid solution (iron, carbon, silicon), amount of oxide and impurities (sulphur, phosphorus, silicon and manganese).

Size of graphite depends on pouring temperature, rate of cooling, time iron has been molten before being poured, per centage of metalloids and total carbon. Graphite dissolves in the iron at temperatures below the melting point and therefore it is only the combined carbon on which the fusibility of cast iron depends. The fluidity is determined by the temperature of the metal, percentage of oxide, percentage of phosphorus and silicon, and the effect the metalloids have on the total carbon as well as the percentage of carbon.

Shrinkage.

Shrinkage is a great factor in using steel, and is dependent not only on the composition but on the size, shape, rate of cooling and whether the casting is made in dry or green sand. Anything that ultimately gives more combined carbon in the finished casting gives more shrinkage. If the iron be cooled quickly, the graphite carbon has not enough time to separate out, therefore the casting is hard and there is more contraction. Fluid contraction of course is quite another thing, as this is caused by bad design or in castings where one section solidifies before the other, the remaining fluid section having no molten iron to draw from its adjacent parts with a resultant cavity or shrink hole.

If, by the use of steel, the total carbon content is lowered, fluid contraction is increased. Fluid contraction can be overcome by the judicious use of chills, gates and risers. Shrinkage is not always uniform, in fact high total carbon, or low total carbon with high graphitic carbon expand before shrinkage, which expansion is due to the separation of graphite. During subsequent shrinkage there may be periods when expansion takes place due to the solidification of phosphide entectic (Steadite), and another expansion may take place when the iron changes from the alpha to the gamma state which would be about 1,300 degs. Fah. By actual measurement a few curves have been made relative to the amount of first expansion and total shrinkage, the results being tabulared as follows:—

% steel	% scrap	Si.	Mn.	S	P.	CC.	GC.	TC	Relative Expansion	Relative Contraction	Chill	T S sq. ins.
0	92	2.18	.54	.162	.691	.94	2.41	3.35	1½	28	1-16	22,800
7	77	[illegible]	.70	.12	.391	1.00	2.60	3.60	0	36	1-16	31,200
20	50	1.50	.60	.134	.474	.80	2.70	3.50	½	26	1/4	27,000
25	50	2.26	.60	.104	.526	.80	2.46	3.26	1½	28	3/8	.....
30	50	1.48	.59	14	.415	99	2.85	3.84	4	27	3/8	32,700
30	70	1.30	.55	.127	.454	.76	2.19	2.95	3½	22	1/4	32,800

From my observations it was noted that the expansion depends on the graphitic carbon and the contraction on the amount of combined carbon irrespective of the quantity of steel in the mixture. I have obtained the same physical results with the air furnace, and with cupola melting without using steel, simply employing varied proportions and compositions of scrap.

Quantity of Steel.

The quantity of steel used depends on the section of the casting and whether machining be necessary or not. If the casting have light and heavy sections it is not easy to select an iron which will run well and be free from spongy spots, etc. Steel in cast iron is said to give greater strength which is true if the composition is arranged accordingly but where fluid hot iron and small sectioned castings are the requisite, the silicon and phosphorous has to be increased to such an extent that the strength is reduced correspondingly. We know silicon and phosphorus are detrimental to good castings as regards their strength, machining qualities and softness, therefore a happy medium in the percentage of steel added for light castings must be found. In very heavy work semi-steel is economical, as it gives a uniform fracture which it is not possible to get with ordinary cupola iron mixtures; the ultimate strength is also high.

For hydraulic work, machine bed ways or places where wear is a factor, when superheated steam is in contact with fittings, for grate bars and furnace parts, semi-steel, when used in the right chemical proportion, is efficient. The table gives suggested analyses and proportions of steel in various mixtures.

Service.	Si.	M.	S.	P.	% Steel
Loco. cylinders and piston rings	1.0 to 1.3	.8	.06	.50	20
Corliss engine cylinders	1.6	.85	.06	.72	20
Automobile cylinders	2–2.25	.75	.07	.40	12½
Hydraulic press beds	1.6	.80	.06	.5	30
Grate bars and heat resisting castings	2.0	.80	.07	.30	40
Auto piston rings	1.8	.35	.08	1.0	10
Auto. castings (fairly heavy)	1.8	.80	.07	.40	20

CALCULATION OF SHAFTING.

By J. A. Adie.

IN the design of machinery, one of the most difficult questions to decide is the minimum size of the shafts to be used to perform a given amount of work. This question is generally one of the first which must be solved, approximately at least, owing to its influence on the shape and size of the other component parts of the design. If our shafts are larger than need be, it often means, beside the waste of material, that a larger pinion, for example, must be used, so that we may have sufficient metal below the roots of the teeth. This for a given ratio of gearing would increase the distance between centres of gears and consequently necessitate a larger and correspondingly cost-

ly frame or housing. It can be readily seen that, as a larger shaft also requires a longer and heavier bearing, the cost of manufacturing is intimately connected with the sizes of shafting used.

The Starting Point.

As the problem usually presents itself, we are given either the belt-pull or tooth-load of the pulley or gear mounted on the shaft, or a very common form is to know the horse-power to be transmitted and the r.p.m. which the shaft makes. In either case, the first thing we must discover is the torsional moment or twist on the shaft in inch-pounds, and we must also find the direct load supported by the shaft considered as a beam. The torsion in the first case will, of course, be the belt pull or tooth load multiplied by the radius of the pulley or gear in inches. In the second case, the twisting moment T may be found by the formula

$$T = \frac{63025 \times \text{h.p.}}{\text{r.p.m.}}$$

If we had only to consider torsion, the question of shaft sizes would be very simple, but this is hardly ever the case, as there is nearly always a load causing a bending movement in the shaft, in addition to the force tending to make it rotate. The torsion is always caused by some force applied at the end of a lever-arm or at the rim of a wheel or gear, this force tending to bend the shaft. If the lever or wheel be placed on the shaft midway between two bearings, the bending moment B will be $\frac{WL}{4}$ where W = force in pounds and L = length between supports in inches, or if placed outside a bearing as in case of an overhung gear, B = WL.

Determining the Total Stresses.

Now, to arrive at an idea of the total stresses in the shaft, we must combine the bending and twisting moments and obtain what is called the equivalent moment. As the bending moment acts at right angles to the twisting moment, it can be seen that the equivalent moment is somewhat as the hypotenuse of a right-angle triangle, or $\sqrt{(B^2+T^2)}$. The formula as given by different authorities varies somewhat. Rankine gives the equivalent bending moment as

$$\frac{1}{2}B + \frac{1}{2}\sqrt{(B^2+T^2)}.$$

A shaft will stand twice the strain in bending that it will in torsion, as the axial moment of inertia $\frac{Pd^3}{16}$ is twice the polar moment of inertia $\frac{Pd^3}{32}$. Thus the preceding formula may be written $\frac{B}{2} + \frac{1}{2}\sqrt{(B^2+T^2)}$ = equivalent twisting moment.

Reauleaux gives the value $\frac{3}{8}B + \frac{5}{8}\sqrt{(B^2+T^2)}$ = equivalent bending moment, while another formula which has been used very successfully makes equivalent bending moment $= \sqrt{(B^2+.5T^2)}$.

Having found the equivalent twisting moment Rr, we may arrive at the diameter (d) of the shaft required from the formula

$$d^3 = \frac{16Rr}{PS} = \frac{5.1Rr}{S},$$

S being the allowable stress per square inch in the shaft, a safe figure to use for ordinary mild steel shafting being 8,000 lbs. per sq. inch. If we find the equivalent bending moment, Bm, the formula becomes $d^3 = \frac{32Bm}{PS} = \frac{10.2Bm}{S}$, using the same value for S as before.

Other Considerations Affecting Diameter.

Now, while a shaft chosen may be of ample size to safely bear all the strains that may come upon it, we may find it necessary to increase the size on other considerations. A long shaft has a tendency to twist through a certain angle at one end, relatively to the other end; it should therefore be examined as to this angle of torsion at maximum load. The angle of torsion in degrees will be $\frac{583.6Rrl}{d^4G}$, Rr being the twisting moment.

l the length in inches and G the torsional coefficient of elasticity = 12,000,000 for steel shafts. The allowable angle of torsion should not exceed .75 degree per ten-foot length of shaft

A shaft should also be examined for deflection or springing between supports, which might be sufficient to throw a pair of gears out of correct mesh, or in case of a shaft transmitting motion by means of levers, would cause considerable lost motion. The deflection can be ascertained by the common formula for beams of circular section and should be limited to 1/300 of the span between supports.

Deflection Example.

Supposing that we require a shaft to transmit 50 h.p. at 150 r.p.m. and driven by a 36-in. gear placed immediately outside the shaft bearing. The turning moment will be $\frac{63025 \text{ h.p.}}{\text{r.p.m.}} = \frac{63025 \times 50}{150}$ 21,008 inch lbs.

The tooth load on the gear is $\frac{21,008}{18}$ = 1,169 lbs. Taking the distance from the centre of the gear to a point of support somewhat inside the end of the bearing as 5 in., then the bending moment will be 1169 × 5 = 5845 inch lbs. The equivalent twisting moment will be $5845 + \sqrt{(5845^2+21008^2)} = 27,645$ inch lbs., then $d = \sqrt[3]{\left(\frac{5.1 \times 27645}{8000}\right)} = 2.6$ in., the size of shaft selected being 2¾ ins. According to Reauleaux's formula, the equivalent bending moment is $\frac{3}{8} \times 5845 + \frac{5}{8}\sqrt{(5845^2+21008^2)} = 15,800$ inch lbs., then $M = S\frac{I}{C}$ or $15,800 = \frac{Pd^3}{32}$, whence d = 2.71 ins., or 2¾ ins., practically the same result as before. M = bending moment, S = stress per sq. inch, $\frac{I}{C}$ = section modulus of shaft.

Using the third formula mentioned, $\sqrt{B(B^2+.5T^2)}$, equivalent bending moment $= \sqrt{(5845^2+.5\times21008^2)} = 15,963$ in. lbs., and $15,963 = 8.000\frac{Pd^3}{32}$, whence d = 2.73 ins., being about the same as in the two former cases.

Since the gear in this instance is located close to the bearing, we may omit to examine this shaft for deflection. Supposing, however, this shaft to be 8 ft. long, the angle of torsion will be

$$\frac{583.6 \times 21008 \times 8 \times 12}{2.75^4 \times 12,000,000}$$

= 1.72° which is below our limit of .75° per foot of length. The foregoing methods relate to revolving shafts only.

There is also a class of shafts in which the motion is oscillating and the angle of movement small, as for example shafts carrying brake levers, operating levers, etc. These shafts may transmit heavy torsional and bending moments, but on account of the small angle of motion, it will be sufficient to calculate them for bending only. The deflection and angle of torsion is especially important in this case and should be carefully ascertained, as a small amount of loss motion will reduce the effectiveness of a brake lever very seriously.

CONCERNING BELT SLIPPAGE

By N. G. Near

WITH reference to R. McLaren's recent contribution "Concerning Belt Slippage," it was I who wrote the article to which he refers in "Woodworker." I will therefore endeavor to

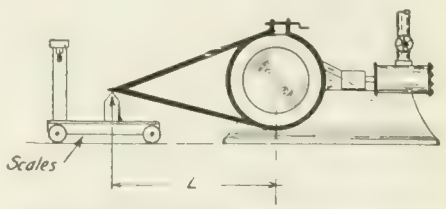


FIG. 1. CONCERNING BELT SLIPPAGE.

explain more clearly why each per cent of belt slippage costs one per cent of

the coal pile, or, as stated in the article, why a slippage of 5.2 per cent. will waste 5.2 per cent of the coal pile.

I will use the example Mr. McLaren cites—a hoisting engine—as it is an ideal one to use. This engine, sketched in the figure herewith, is so arranged that it will raise a weight of 33,000 pounds one foot high in one minute, which is equivalent to doing the work of one horse power. Now, when there is no slip in the "clutch ring" which I have shown, all of the mechanical energy delivered by the engine will be expended in lifting the weight. However, on giving the matter thought, it will be clear to any reader that Mr. McLaren is wrong when he says—"If the clutch be applied to slip so that the weight is raised ½ ft. in one minute, only ½ horse power of work will be performed, and about half as much coal will be used, instead of half the coal being wasted as 'wood-worker' claims."

I will explain it in this way:—Let us assume that the 33,000 pounds weight does not move upward at all, while the engine is running at normal speed. The weight is hanging there and is certainly exerting a tension of 33,000 pounds through the cable. It is being held there by the "friction" of the clutch ring. If there were no friction the weight would fall. Therefore, the engine is doing work even though the weight does not move a millionth of an inch. In fact, the engine is doing just as much work as it would be doing if the weight were moving upward at the rate of one foot per minute. This is true for the same reason that in a Prony brake, Fig. 2, the power of an engine is determined by measuring the pressure P on the scales, multiplying it by the "theoretical" distance through which it moves in one minute (which is 2LTTN) and dividing by 33,000. The brake and scales do not move at all, yet, power is being developed.

In the case of the hoisting engine and the 33,000 pound weight, the case is identical. In fact, many Prony brakes are designed on that very principle, i. e. with suspended weights. The behavior of the engine—cut off, etc., is just the same when the suspended weight is not moving as when it is. The only way in which the power could be reduced with a weight moving more slowly would be to "gear down" the speed of the cable; then, the horse power delivered by the engine would be directly proportional to the speed at which the weight is being raised, neglecting transmission friction through gearing, and assuming that there would be no slip in the clutch.

The same is true with belts. If we had a belt that did not move at all, but in which the tensions were the same as when pulling full load, the engine would be dissipating energy at the same rate at which it is spent when pulling full load. We would then have a belt-Prony-brake. Where belt slip is 50 per cent, one half of the fuel is wasted, and where there is no belt slip, no fuel is wasted on that account, but it is always directly proportional to the slip except in cases where tensions change while slip takes place. Usually, though, where slip is 5 per cent or thereabouts there is very little change in belt tension, if any.

For these reasons, in gasoline engine belts, where speed fluctuations are often rather violent, the slip occurs at the time when tensions are greatest and therefore each per cent of slip represents more than one per cent of fuel loss.

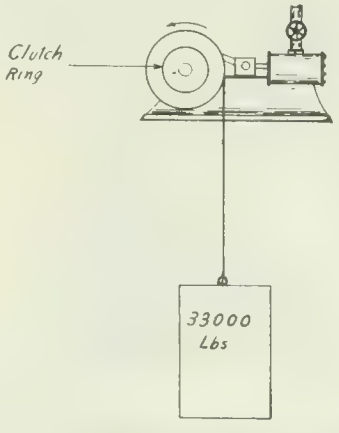


FIG. 2. CONCERNING BELT SLIPPAGE.

A slipping belt is therefore expensive, not only in the cost of the wearing out of the belt, but in the cost of the wasted fuel.

Stimulating Effort.

By J. T.

IT is easy for anyone to criticize; there are, therefore, more critics than boosters. A friendly or kindly word of commendation has often proved the incentive for a worker to go on and do better, it being human nature to esteem admiration and encouragement from one's fellow-man.

A few words of praise may cause a certain type of man to stop his forward march, his reasoning being somewhat as follows: If the boss thinks I am "it," I guess, as things are, I am good enough for keeps. This class of man will never amount to much in the engineering game, and unless he is driven along by harsh words he will not do an honest day's work. In his hours of freedom he will generally be found around bars or pool-rooms, or some other equally-to-be-avoided resorts, and no amount of boosting would do him any good. It is a pleasure to know that this kind of man is not very numerous among machine shop operators.

Even if they do not receive any boosting from "the boss," mechanics can depend upon their trade journal for a certain amount of encouragement. I know of more than one man who had the blues and got rid of them by taking his troubles (by mail) to the editor of his engineering paper. The operator will always be sure of getting a number one brand of good advice and some "straight-from-the-shoulder" words of encouragement in addition.

At the present time, when all classes of publications are commenting upon the high cost of living, the engineer is forced to consider success not only from the standpoint of doing his duty in manner that leaves nothing to be desired by his employer, but he must also consider the "cash received for services rendered" side of the question. He may be a perfect success in a small plant, and be absolutely certain that he lacks the skill and experience to handle a better paying situation offered to him, but the fact that his wife and children have insufficient food and proper clothes may tempt him to take the position.

It is difficult to give advice off-hand in a case of this kind, for many men have taken positions above their class. They have done so, however, with a determination to make good and in many cases they have won out. It is nevertheless a dangerous game to play in engineering. Ambition is a fine thing, while grit and common "horse sense" are better, yet absolute necessity has made more "top notchers" than both combined.

The man who shirks his work because he is overworked, underpaid, and never "boosted" has not enough "horse sense" to make a success of himself anywhere, much less in an engine-room. To become a "top notcher," an engineer must never be satisfied that further improvement is impossible, either in his ability or in the equipment under his charge. He must be continually upon the alert to improve conditions, to decrease operating costs, and with these ends in view he may not discontinue his technical journal and engineering book studies.

MOTOR THROWING OIL.

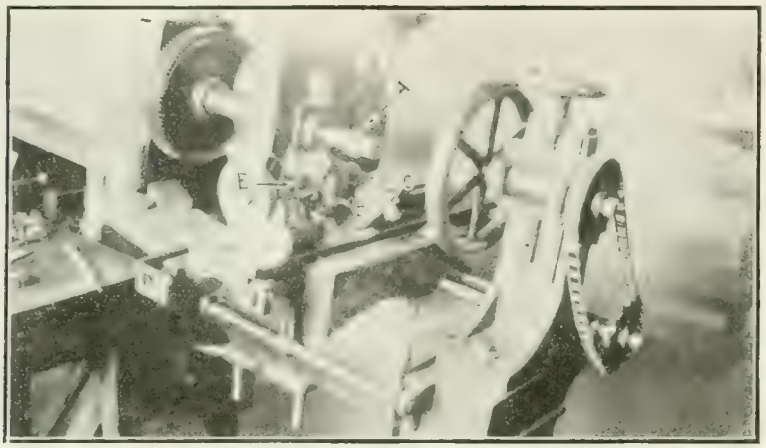
By E. C. Parham.

THE tendency of motor bearings to throw oil, that is eventually drawn into the motor to saturate its windings, may be due to a hot bearing, or to a defective bearing, or to excessive and careless application of oil, or to the overflow pipe being stopped up, or to a pumping action that may become effective as the result of excessive lining wear. In most cases, however, excessive and careless oiling is responsible.

Except where information is furnished

as to the amount of oil required to refill a bearing, or to renew normal loss, it is the better plan to apply the oil through the overflow pipe. By carefully noting the level of the oil in this pipe, while slowly pouring it in, a reliable indication of the oil level in the bearing becomes available. Most caretakers resort to the quicker method of applying the oil through the top opening of the bearing. The objections to this method are that, unless the oiler is careful, he will spill oil outside, or if he is careful, but continues to pour oil in until he sees a little run out of the overflow pipe, the overflow will continue for some time after the oiler leaves, since a certain amount of time is required for the oil to work its way down from above, and up through the overflow pipe.

An inspector was asked to prescribe for an elevator motor that was "throwing oil." The motor windings, brushes, brush rigging, slip-rings, floor and elevator platform were saturated and wherever oil could stand in pools it did. If the motor had been engaged in pumping oil, it could hardly have made a better showing. The inspector cleaned everything concerned with the motor, flushed out the bearings with gasoline, refilled the bearings through the overflow pipe until the oil came up to within ¼ inch of the top of the overflow, and then had a heart-to-heart talk with the oiler—which produced satisfactory results.—General Electric Review.



FIXTURE FOR MILLING TOOTHED WHEELS.

FIXTURES FOR MILLING TOOTHED WHEELS.

By D. A. Hampson.

FIVE thousand specially toothed wheels were required for a new device. These wheels were to have twenty-four teeth, ⅛ inch high, of ⅛ inch radius, equally spaced about the circumference. The blanks for the wheels were punched from cold rolled steel 3-16 inch thick and a hole .430 inch diameter was also punched in the centre and finished to 7-16 inch with a reamer. It was required to cut the teeth concentric with this hole within a limit of 0.0015 inch smaller or larger, the diameter being given as 3 inches.

The part of the work to be considered will be the cutting of the teeth and the tools used for the same. Naturally, a low cost for the job was desired; no more of the wheels would ever be wanted and so any special fixtures would have to be thrown away after the completion of the work.

A Lincoln miller in first-class condition was elected for the job and a "stub" arbor of the shortest length that could be used was made up. A pair of B. & S. high-speed formed cutters were purchased—the cutters of a form that finished three teeth at one passage—therefore eight indexings per revolution of the wheels finished one set. The cutter is shown at A in position on the arbor.

The headstock from a set of plain index centres was stripped of the worm shaft and the live "centre." In place of these, a tool-steel, hardened arbor was supplied, the arbor carrying a flange 2¾ in. diameter, which was bolted to the dogplate of the head. Four wheels were clamped on the arbor at one time. At the tailstock end the arbor was threaded for a large thumb-nut, drilled with a ⅜ inch drill for tapping, and beyond the threads was turned ⅜ by 1 inch to go in a hardened bushing in the tailstock. This provided substantial support for the work at the tail end and though the nuts with the shallow thread gave out, the hardened arbor showed no signs of wear. A washer of the ball and socket type between the nut and the wheels prevented any bending of the arbor which might have occurred had any of the wheels been slightly warped.

Before doing the work it was assumed that to try to cut more than four wheels at a time would delay the work, the time involved in loading and unloading the close-fitting pieces, cleaning of chips, and the spring of a longer arbor all being considered. The actual work proved this assumption to be well founded.

Indexing was simplified by having only eight holes to "catch" with the index pin; the other holes on the circle were plugged so that no mistake could be made. A special index pin, E, was made having a long cross bar for easy working and an extension at one end over which a spring was slipped. Then to index from one hole to the next, the operator took hold directly on the worm gear with one hand and as the pin was released with the other hand gave the gear a turn until the pin dropped of itself into the next hole. The pin and spring may be seen in the photo.

A special tail-stock is shown at B. It is a casting fitted with a slide into which is pressed the bushing for supporting the arbor. The slide is clamped by a single nut to which the wrench C is fited, so that it will not come off. Releasing the nut and moving the slide back gives ample room for loading the work with ease and comfort—the tail-stock is made U-shaped to give plenty of clearance around the wheels. The slide joins the U together at the top; a pin prevents the slide from being shoved out too far.

So that no time would be wasted on unnecessary movement, an L-shaped stop, marked D, was made for the table to stop against in the nearest safe distance from the cutter when loading and unloading. The movement for cutting the teeth was such as to just clear the cutter when the wheels were turned and was controlled by a hinged block inside of the "L"—hinged so that it could be swung out of the way when loading (in the photo it is thus, and cannot be seen). Every inch which any operator might unthinkingly move was saved and controlled by parts heavy enough to withstand abuse. Not a single loose piece, excepting one thumb nut and washer, had to be handled.

The hand reverse feed was altered as shown so that the operator could do all his work while seated without moving. A link belt and two sprockets—both in stock—carried the feed to the back shift. One sprocket and the hand-wheel are keyed to a short shaft turning in a sleeve in the tail-stock clamp. A guard, not shown, was provided for the chain.

In service, the whole arrangement was found as nearly ideal as any, not automatic, could be and no changes from the original plan were made. An average of 140 wheels per day of ten hours was turned out, all within the required limits of accuracy and finish. One of the wheels is shown against the headstock and a pile of them are to the left. The cutters milled an average of 600 wheels between sharpenings. Seated, with a bench at his side, the operator had time to remove the burrs between the cuts.

PROGRESS IN NEW EQUIPMENT

A Record of New and Improved Machinery and Accessories for the Pattern, Boiler and Blacksmith Shops, Planing Mill, Foundry and Power Plant

ENGINE LATHES WITH ATTACHMENTS FOR SHELL WORK.

THE standard engine lathe can be rendered more efficient on shell work when equipped with certain special attachments. These latter can, of course, be readily removed at any time and standard parts applied, thus rendering the machine ready for its regular work. The Niles-Bement-Pond Co. are furnishing lathes equipped with several types of attachments which adapt them to high production of duplicate work in the finishing of shrapnel and different sizes of high explosive shells, both of the solid and hollow-forged types.

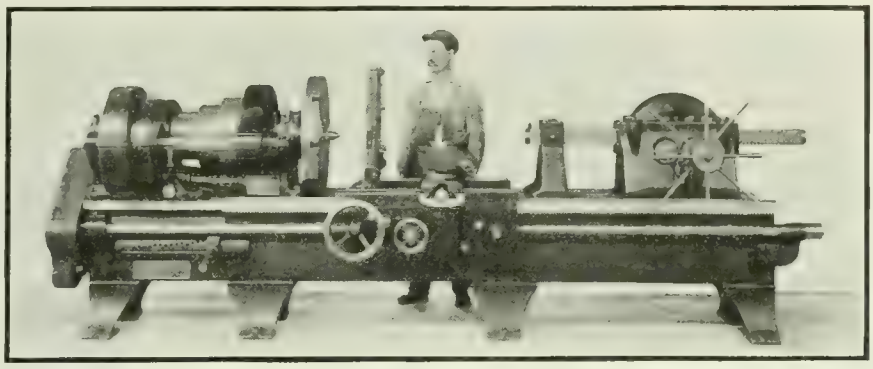


FIG. 1—FRONT VIEW OF 26-IN. DOUBLE BACK GEARED ENGINE LATHE EQUIPPED FOR BORING HIGH EXPLOSIVE SHELLS.

Boring Tailstock.

Figs. 1 and 2 show front and rear views respectively of a 26-in. double back-geared engine lathe, equipped with a boring tailstock for boring high explosive shells of either the solid or hollow forged type. With the exception of the tailstock, the lathe is the standard type of latest design with improved features. The boring tailstock and support can be readily removed and a standard tailstock applied for regular work. The interior contour of the shell is obtained by the use of bottoming and forming tools built to suit the requirements of each case.

The tailstock is fitted with a square forged steel boring ram, the latter having power feed by means of a shaft geared to the driving works and running along the rear of the bed. The shaft drives through worm and worm wheel to the pinion and rack on the ram, this giving a smooth, positive motion. Large pilot wheels are provided for hand traverse of the ram and for starting and stopping the feed. The lathe is equipped with quick-change gear feed mechanism. To prevent vibration of tools, the boring ram is provided with a support, which can be adjusted along the bed to a position near the work. A standard tool carriage for turning operations forms part of the equipment, a steady rest being also furnished for supporting either a pot chuck or the shell itself as the case may be.

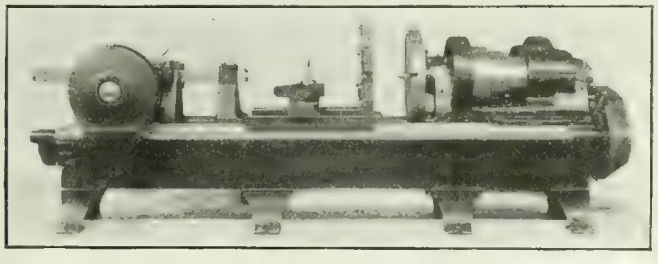


FIG. 2—REAR VIEW OF 26-IN. DOUBLE BACK-GEARED ENGINE LATHE FOR BORING HIGH EXPLOSIVE SHELLS.

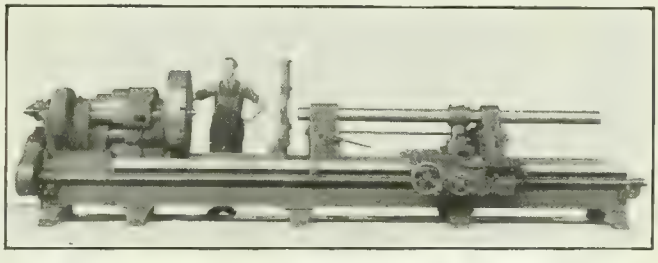


FIG. 3—SHOWING A 36-IN. TRIPLE-GEARED ENGINE LATHE EQUIPPED FOR STRAIGHT OR TAPER BORING OF SHELLS.

Attachment for Straight or Taper Boring.

Fig. 3 shows a 36-in. triple-geared engine lathe equipped with a boring bar, mounted on the carriage, and arranged for either straight or taper boring of shells. The boring bar is carried in a bearing with a swiveling base mounted in the carriage. Two supports are provided for the bar, one on either side of the carriage. These supports consist of a bearing for the bar mounted on a slide, which has cross adjustment on a substantial base. For taper boring, the support near the shell is shifted to one side of its central position and the other end support shifted to the other side of its central position. The support bearings have means of swiveling a sufficient amount. The central bearing

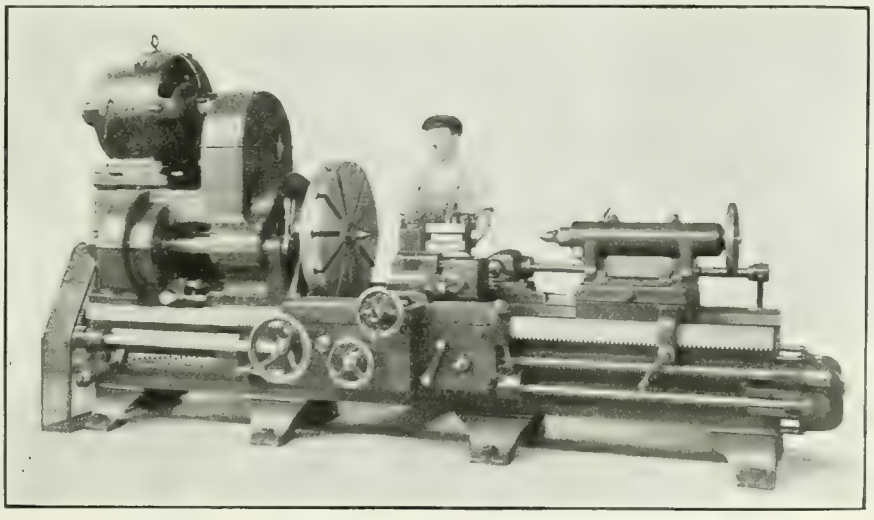


FIG. 4—SHOWING A 30-IN. DOUBLE BACK-GEARED ENGINE LATHE EQUIPPED FOR WAVING AND GROOVING COPPER BAND SEAT OF SHELLS.

of the bar is arranged to slide in and out on the carriage as the bar is fed.

The bar can be adjusted bodily across the lathe so that the cutter can be traversed inside the shell and fed into the work and at the same time always remain at a given set taper. This is accomplished by having the slides of the two end supports connected by screws and gearing so that they move simultaneously when adjusted by the ratchet wrench shown on the support nearest the headstock.

Attachment for Cutting Waves and Grooving Band Seats.

Fig. 4 shows a 50-in. double back-geared lathe of the latest design, equipped with an attachment for cutting the waves and grooving the copper band seats of shells.

The standard compound tool rest has been removed from the carriage and a special rest substituted. This consists of a lower slide, which is mounted directly in the carriage and has cross adjustment by a hand screw. Mounted on this lower slide is a tool slide. In order to obtain the wave effect, this tool slide is given a reciprocating motion parallel with the bed while the projectile revolves. This motion is obtained by means of an eccentric carried on a cross shaft which is journaled in the cross slide. The cross shaft is driven by bevel gears from a shaft located along the back of the lathe. This latter shaft is geared to the main spindle of the head, and suitable change gears are provided for obtaining the number of waves per revolution required on different sizes and types of shells. The eccentric is adjustable to produce the desired amount of the wave, and the depth of the wave rib is determined by the shape of the formed tool.

On lathes equipped with this attachment, it is customary to furnish also a four-sided turret tool post on the rear of the carriage. This permits all the operations on the band seat to be performed at one setting of the projectile in the lathe.

PORTABLE ELECTRIC DRILLS.

THE value of portable electric drills in the manufacturing plant is forcibly shown in the accompanying illustration, where electric drills, manufactured by The Standard Electric Tool Co., Cincinnati, Ohio, are being used. They are adapted to many classes of work, as will be noted. These drills are made in all sizes for both small and large work, the small tools having high speed and being very light in weight, which enables operators to drill holes in metal or wood with great rapidity.

Owing to the fact that a lamp socket connection is the only thing necessary to drive this equipment, the cost of installation is only that of the drills, no shafting or belting being necessary. The tools shown are of the universal type which operate on both alternating and direct current. They are employed on outside jobs, such as erecting, or where drilling has to be done. The feature of being interchangeable on either current gives them a very wide range of work.

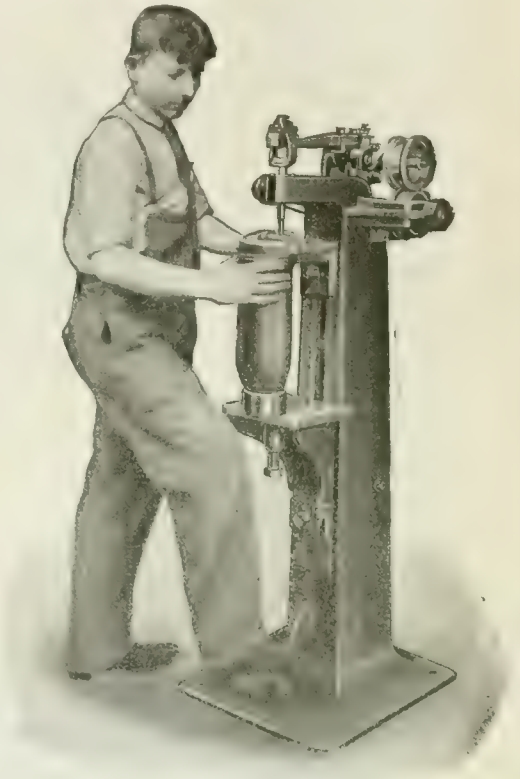
On large metal sheets, drilling can be done right on the floor, and the difficulty of moving to a punch or drill press is eliminated. The principle of taking the tool to the work is very vividly illustrated here. In cases where the holes have been previously punched and do not match, the electric drill is used for reaming out.

The illustration shows holes for fittings and attachments to pipes and ventilator sections being produced by electric drills.

PORTABLE ELECTRIC DRILLS AT WORK

ROTARY VIBRATING RIVETING MACHINE.

THE rotary vibrating riveting machine made by the Grant Mfg. & Machine Co., of Bridgeport, Conn., has been especially fitted up to rivet over the base of the explosives projectile shown, in order to hold the gas plate securely in position.



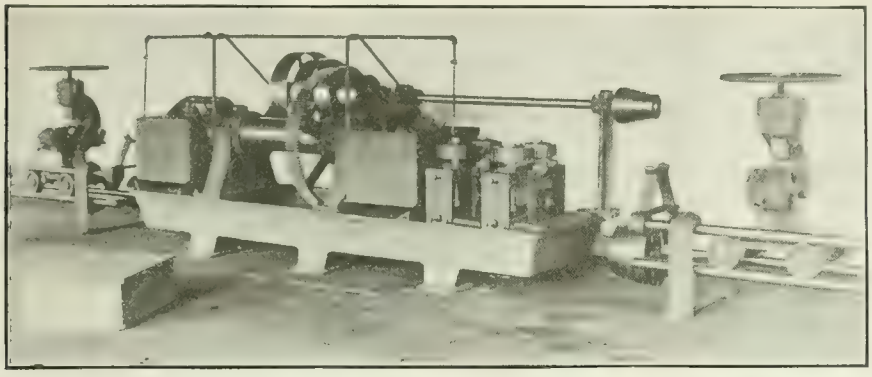
ROTARY VIBRATING RIVETING MACHINE

In order to prevent the possibility of the base of the shell being porous in the slightest degree, the end is recessed and threaded to receive a steel plate, the inner face of the latter being coated with a special cement before being screwed into place. The plate screws down below the back end of the shell sufficiently to allow the base of the shell to be peened or riveted over it, preventing the possibility of its coming loose.

The machine is fitted with a special ball-bearing revolving fixture which fits the nose of the shell before the plug is screwed into the nose, and the base of the shell is supported in a position which brings the vibrating hammer exactly over the joint where the base plug is screwed into the shell. The shell is rotated one complete revolution by hand, and, with the machine striking about 2,000 blows per minute, the plug can be riveted perfectly tight into the base in about ten seconds. With a change of fixtures, the machine can be adapted for 4.5 in., 18-pdr., or shells even larger than 4.5 in.

MACHINE FOR TURNING VANADIUM AND SPECIAL ALLOY STEEL SHELL BLANKS.

THE illustration and description refer to a product of the Brightman Mfg. Co., Columbus, Ohio, the purpose of which is the preparing or rough turning of vanadium or special alloy steel blanks, for conversion later on automatic machines into shrapnel or high explosive shells. the material when so treated being, it is claimed, perfectly round and true to size. With this machine it is possible to turn from 1,000 to 1,500 ft. of 2-in. round material in ten hours, and, taking this as a base, sizes 1 in. and up to 6 in. can be turned and finished in proportionate quantities.



MACHINE FOR TURNING VANADIUM AND SPECIAL ALLOY STEEL SHELL BLANKS.

The rough bar or rod is fed in at one end of the turning machine by a set of feed rolls driven by worm wheels and worms attached to perpendicular and horizontal shafts, a four-step cone regulating the feed. Material, after leaving the feed rolls, enters the roughing head, which reduces it very nearly to size. This head, as well as the finishing head, is composed of a steel cutter and guides set in the segmental slots, which have a screw adjustment. These heads are bolted to a cylinder having hollow bearings, through which material passes in the process of turning, and are driven by a gear and pinion. The latter is attached to a horizontal shaft, on which are different sizes of pulleys to give various speeds to the machine; or the latter can be motor driven. After leaving the roughing head, the material passes through the hollow cylinder into the finishing head, which turns it to size, and ready for the automatic machines.

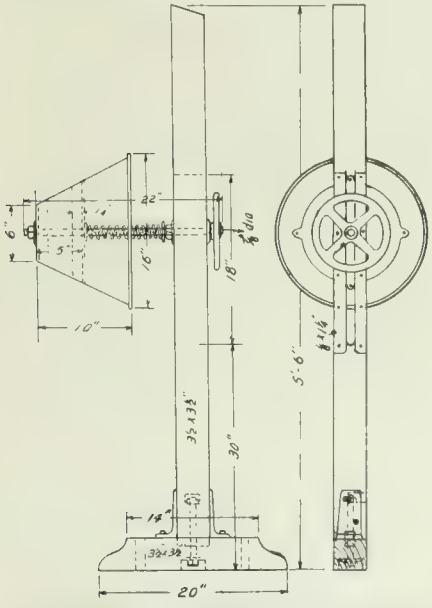


FIG. 2. DETAIL OF CENTRE FOR GALVANIZED PIPE WORK.

The bed of the machine is a receptacle for a soap solution, which is continually pumped on the cutters by a small pump on the rear. This drains back into the bed to be used again. Boxes surrounding the cutter heads are used for chips or turnings, and are so arranged with opening sides that they can be readily cleaned while the machine is in operation. At each end tracks are provided with a gripping device, which keeps material from revolving with the machine.

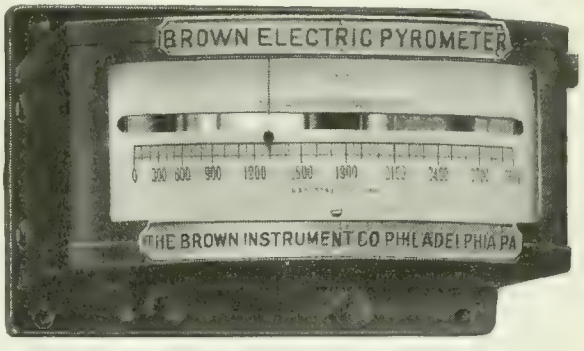
CENTRES FOR GALVANIZED PIPE WORKING.

By A. E. Granville.

A VERY convenient support for tin or galvanized iron pipe during the beading or crimping operation is shown by Fig. 1 and in detail by Fig. 2. Two of the supports are shown in position at A and B for work done on the machines, C and D. These centres may be raised or lowered to suit by means of the clamps E and F. The centre cones are made of heavy galvanized iron, and are backed by spiral springs, which keep the work pressed securely against the stops G and H on the machines, so that, when set, all the operator has to do is to throw in the clutch and watch the work revolve between the rolls.

HIGH RESISTANCE PYROMETER.

OUR illustration shows the high resistance pyrometer manufactured by the Brown Instrument Co., Philadelphia, Pa.



HIGH RESISTANCE PYROMETER.

This apparatus has a resistance of 200 ohms or more; it is therefore applicable to hardening, heat-treating and annealing furnaces where accuracy is a sine qua non. Originally pyrometers were all of the low-resistance type, and it has only been in recent years, we understand, that those of high resistance have become available.

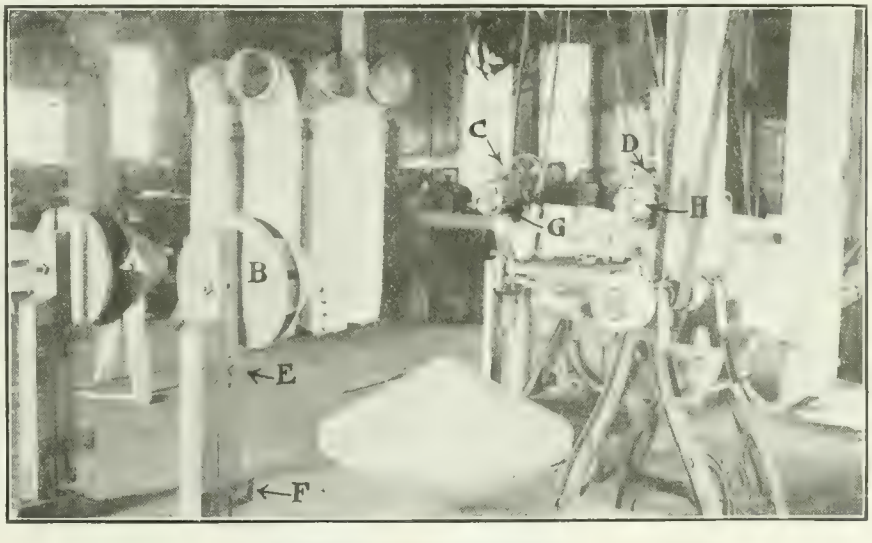


FIG. 1.—CENTRE FOR GALVANIZED PIPE WORK.

THE COMING FOUNDRYMEN'S CONVENTION.

ACTIVE preparation is being made in every direction for the coming convention at Atlantic City, N.J., the American Foundrymen's Association and allied bodies, and there is little doubt that, when the week of September 27, 1915, arrives, everything will be in apple-pie order for this wide scope function.

The occasion will be marked by the annual meetings of the American Foundrymen's Association and the American Institute of Metals as well as the yearly exhibit of foundry supplies and equipment conducted under the auspices of the Foundry & Machine Exhibition Co. Heretofore, the Associated Foundry Foremen have held their meetings during this week, but since this organization has dissolved and its members have become affiliated as associates with the American Foundrymen's Association, they will take part in the deliberations of this society.

The program of the American Foundrymen's Association, while yet incomplete, has already assumed large proportions and to permit of full discussion of the many valuable papers that will be presented, two simultaneous sessions on malleable and steel castings will be held. The business meeting, which heretofore followed the close of the technical deliberations, will be held on Wednesday evening, Sept. 29, when the new officers will be elected and the business affairs of the association will be discussed.

A gratifying increase in membership has been recorded during the year, the enrollment now approximating 1,000, of which more than 150 are associates. The campaign for new members resulted in the addition of nearly 100 new names, and at the annual meeting it is believed a still further growth will be reported. Financially the society is in better condition than at any time in its history, and the balance in the treasury will permit of increasing the scope of the work that is now being carried on.

A partial list of papers that will be presented, follows:

"Resume of Advances in Foundry Practice," by Richard Moldenke.

"Application of Various Types of Molding Machines to Different Classes of Work," by I. J. Wilson and A. O. Backert.

"Time Studies on Molding Machines," by H. K. Hathaway, Philadelphia.

"Functions of Sand Binders," by H. M. Lane, Detroit.

"The Reclamation of Molding Sand," by W. M. Saunders and H. B. Hanley.

"Relation of the Foundry Foreman to the Manager," by S V. Blair.

"Manufacture and Constituents of Pig Iron and the Essentials in the Purchase of this Material," by O. J. Abell, Chicago.

"Pouring Systems for Gray Iron Shops," by H. Cole Estep.

"Fuel Oil Cupolas," by Bradley Stoughton, New York City.

"Thermal Reactions in Melting Gray Iron," by Dr. Joseph Richards, Lehigh, Pa.

"The Inspection of Automobile Castings," by C. B. Wilson, Pontiac, Mich.

"Defects in Gray Iron Castings and Remedies for Them," by Herbert Ramp, Cincinnati.

"The Value of the Vibratory Test in Steel Foundry Practice," by Lloyd Uhler, Pittsburgh.

"The Particular Application of the Converter in the Manufacture of Steel Castings," by C. S. Koch, McKeesport, Pa.

"Notes on Electric Furnace Construction and Operation in the Steel Foundry," by Mr. Gray, United States Steel Corporation, New York City.

"Correct Proportions and Essentials in Checker Design for Open Hearth Furnaces," by W. A. Janssen, Bettendorf, Ia.

"Causes for Shrinkage Cracks in Steel Castings," by William Bossinger, Marion, O.

In addition to the foregoing, reports will be presented by the committees on safety and sanitation, industrial education, costs, steel foundry standards, specifications for malleable castings, specifications for gray iron castings, specifications for steel castings, and specifications for foundry scrap.

Aside from the many attractions afforded by Atlantic City, the entertainment features will involve a theatre party and banquet, and a committee will be in charge of plant visitation, whose members will direct the visiting delegates to the many interesting foundries in Philadelphia and vicinity. It also is probable that numerous side trips will be arranged to enable visitors to inspect the shops in which they are interested, with the least amount of inconvenience.

Headquarters for the American Foundrymen's Association will be at the Marlborough-Blenheim Hotel. The meetings will be held on Young's Steel Pier, where the registration booth also will be located.

Foundry and Machine Exhibition.

C. E. Hoyt, secretary of the Foundry & Machine Exhibition Co., Lewis Institute, Chicago, reports that the space reservation already made, foreshadows one of the largest exhibitions ever held. Young's Steel Pier is admirably adapted for show purposes, and all facilities are provided for the rapid building and installation of machinery. The exhibition will be opened formally on Saturday, Sept. 25, and will close Friday, Oct. 1.

American Institute of Metals.

The headquarters of the American Institute of Metals will be at the Hotel Traymore, and the meetings will be held either there or on Young's Million Dollar Pier. The provisional programme is as follows:

D. H. Newland, Assistant State Geologist, New York—"Albany Sand."

A. D. Flinn, Board of Water Supply, New York—"Experience with Brass in Civil Engineering Work."

C. P. Karr, Bureau of Standards—"Molding Sand."

Charles Pack, Doehler Die Casting Company, New York—"Aluminum Die Casting Work."

Dr. Burgess and Dr. Merica, Bureau of Standards, Washington, D.C. —"Cracking of Wrought Brass from Overstrain."

William W. Clark, Seymour Manufacturing Company—"Manufacture and Use of Alumino-Vanadium."

C. V. Powell, British Aluminum Company, Toronto, Ont.—"Some Developments in Aluminum."

Russell R. Clarke, Pennsylvania Lines West—"The Advantage of a Standard Railroad Bearing Alloy (The Journal Bearing Shell, not the Lining)."

Dr. Weintraub, General Electric Company—"Silicon Resistance Furnaces for Melting Brass."

G. H. Clamer, The Ajax Metal Company—"Effect of Zinc on Copper, Tin and Lead Alloys."

W. M. Corse, The Titanium Alloy Manufacturing Company—"Copper-Aluminum Alloys."

Jesse L. Jones, Westinghouse Electric & Mfg. Company—"Forging Manganese Bronze."

S. L. Hoyt, University of Minnesota—"Amorphous State of Metals."

S. W. Parr, University of Illinois (Two Papers —"Method of Analysis for Complex Alloys," "Development of Acid Resistance Alloys."

Dr. Rawdon, Bureau of Standards, Washington—"Metallographical Examination of 88-10-2 Alloy."

F. A. J. FitzGerald, FitzGerald Laboratories—"Electric Furnaces for Brass Melting."

H. T. Kalmus, Kalmus, Comstock & Westcott, Inc.—"Cobalt in Non-Ferrous Metals."

Dr. S. Trood, U.S. Sherardizing Company—"The Electric Furnace for Sherardizing."

W. E. Barlow, Virginia Polytechnic Institute.

Thomas F. Wettstein, United Lead Company—"The Effect of the Present European War on the Metal Industries."

Elwood Haynes, Haynes Stellite Works —"Stellite."

Prof. D. J. Demarest, Ohio State University—"Analysis of Babbitt Metals."

The MacLean Publishing Company
LIMITED

(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - President
H. T. HUNTER - - - - - - - General Manager
H. V. TYRRELL - - - - - Asst. General Manager

PUBLISHERS OF

CANADIAN MACHINERY AND MANUFACTURING NEWS

A weekly newspaper devoted to the machinery and manufacturing interests.

PETER BAIN, M.E., Editor.

Associate Editors.

A. G. WEBSTER, J. M. WILSON, J. H. RODGERS.

B. G. NEWTON - - - - - - Advertising Manager

OFFICES:

CANADA—
Montreal—Rooms 701-702 Eastern Townships Bank Building. Telephone Main 1255.
Toronto—143-153 University Ave. Telephone Main 7324.
Winnipeg—34 Royal Bank Building. Telephone Garry 2313.

UNITED STATES—
New York—R. B. Huestis, 115 Broadway. Phone 8971 Rector.
Chicago—A. H. Byrne, Room 607, 140 South Dearborn St. Telephone Randolph 3234.
Boston—C. L. Morton, Room 733, Old South Bldg. Telephone Main 1024.

GREAT BRITAIN—
London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C. E. J. Dodd, Director. Telephone Central 12960. Address: Atabek, London, England.

SUBSCRIPTION RATES:

Canada, $2.00; United States, $2.50; Great Britain, Australia and other Colonies, 8s. 6d. per year; other countries, $3.00. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by letting us know. We should be notified at once of any change in address, giving both old and new.

Vol. XIV. JULY 22, 1915 No. 4

PRINCIPAL CONTENTS.

Principles of Design and Lubrication of Bearings 91-92

General 92-93
High Explosive Shell Manufacture....Brass Melting Query ...Selective Assembly

New Process Developments 94-95
Economy and Efficiency of Copper Cyanide....Welding Up Scrap Nickel Anodes.

Production Methods and Devices 96-97
Jobbing Pulley Practice....Safety First The Sheet Metal Punch Press....A 2-Inch Hollow Mill

General 97-98
Ball Bearings for Mill Line Shafting.

Editorial Correspondence 99-102
Concerning Semi-Steel....Calculation of Shafting.... Concerning Belt Slippage....Stimulating Effort.... Motor Throwing Oil....Fixture for Milling Toothed Wheels.

Progress in New Equipment 103-105
Engine Lathes With Attachments for Shell Work.... Portable Electric Drills....Rotary Vibrating Riveting Machine....Machine for Turning Vanadium and Special Alloy Steel Shell Blanks....High Resistance Pyrometer.

General 105
Centres for Galvanized Pipe Working.

The Coming Foundrymen's Convention 106

Editorial 107

Selected Market Quotations 108-109

The General Market Conditions and Tendencies 109-112
Toronto Letter....New War Order Department.... American Engines for British Patrol Launches.... Canadian Commercial Intelligence Service.

Industrial and Construction News (Advtg. Section) 52

EMPIRE SERVICE PRIVILEGE AND OPPORTUNITY.

WE have now got well past the inquiry stage as to who started this huge-scale war in Europe, the effects of which become more far-reaching all the time. Its finish is the all-important matter to-day, and this involves both men and munitions on a scale hitherto undreamed of. In the matter of manufacturing shells for the service of the Motherland, what we have already done may be taken as more or less of a preliminary effort only, because in no sense could it be said, except until recently, that our engineering and metal-working plants had mobilized their operative staffs and equipment on a war footing. This consummation has, however, materialized.

As in the matter of munitions' supply so has it been with the enlistment of our men for active service. True it is we promptly met the invitation to furnish both a first and second overseas service contingent, yet notwithstanding, it was but faintly realized, if at all, the nature of the task set our Empire and her Allies, and through them the desperateness of the mission and undertaking in which our fellows had embarked. Heavy casualty lists of more or less daily occurrence during the past few months have had an enlightening as well as a sobering and saddening effect, more especially as in spite of them all, the achievement has been in no wise such as to speedily bring an end to the conflict.

Speaking generally, we are much more alive to the call of Empire to-day than ever before, so much so that we are getting keenly enthusiastic about it. A growing-in-intensity response is being made by much of our manhood to the further invitation to enlist for overseas service. It has come home to us, that, no matter who started the war, we must needs bear a hand in finishing it, both thoroughly and expeditiously. The selfishness to which all of us are in some degree naturally addicted and have consciously or unconsciously cultivated still combats successfully the call for self-sacrifice, for such the call is.

No male in good health and without disability, and unmarried, between the ages of 18 and 30 years, is entitled to be classed as a man who does not in this crisis put his Country and Empire before every other consideration. The one and only immediate career of any real value to-day for our youths and young men is that of a soldier, and it goes without saying that the opportunity let slip now can never be redeemed. Let us get away, therefore, from the everywhere - prevalent, and instilled-in-our-individual-nature, idea that we are too important in some sphere of business activity to be spared, or that we are so highly educated or so richly endowed with this world's goods that it would be infra dig for us to take our place on the firing line and be a target for Germans to shoot at. As good, yes and better than the best, most gifted, and endowed of us, have stood in the trenches of Northern France and Belgium during the past twelve months, and have given their lives for a cause that not a few among us deem very much secondary to self.

There is a place to fill and a part to play in our Empire's cause by every citizen of our Dominion at this time, and none of us need long remain in ignorance of our relation thereto. If we are not actively aiding in the manufacture of munitions of war we should be making appreciable progress towards the trenches, and, if neither, then why not?

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products.

PIG IRON.

Grey Forge, Pittsburgh	$13 20	$13 45
Lake Superior, charcoal, Chicago	.....	15 75
Ferro Nickel pig iron (Soo)	.....	25 00

	Montreal.	Toronto.
Middlesboro, No. 3	21 00	.....
Carron, special	22 00	.....
Carron, soft	22 00	.....
Cleveland, No. 3	21 00	.....
Clarence, No. 3	21 00	.....
Glengarnock	25 00	.....
Summerlee, No. 1	25 00	.....
Summerlee, No. 3	25 00	.....
Michigan charcoal iron	25 00	.....
Victoria, No. 1	21 00	19 00
Victoria, No. 2X	21 00	19 00
Victoria, No. 2 Plain	21 00	19 00
Hamilton, No. 1	20 00	19 00
Hamilton, No. 2	20 00	19 00

FINISHED IRON AND STEEL.

Per Pound to Large Buyers.	Cents.
Common bar iron, f.o.b., Toronto	2.20
Steel bars, f.o.b., Toronto	2.20
Common bar iron, f.o.b., Montreal	2.20
Steel bars, f.o.b., Montreal	2.20
Bessemer rails, heavy, at mill	1,25
Steel bars, Pittsburgh	1.25
Twisted reinforcing bars	2.15
Tank plates, Pittsburgh	1.25
Beams and angles, Pittsburgh	1.25
Steel hoops, Pittsburgh	1.30
F.O.B., Toronto Warehouse.	**Cents.**
Steel bars	2.10
Small shapes	2.35
Warehouse, Freight and Duty to Pay.	**Cents.**
Steel bars	1.65
Structural shapes	1.75
Plates	1.75

Freight, Pittsburgh to Toronto.

18.9 cents carload; 22.1 cents less carload.

BOILER PLATES.

	Montreal.	Toronto.
Plates, ¼ to ½ in., 100 lb.	$2 35	$2 25
Heads, per 100 lb.	2 55	2 45
Tank plates, 3-16 in.	2 60	2 45

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$12 50	$12 50
Copper, crucible	14 50	14 50
Copper, unch-bled, heavy	14 00	14 00
Copper, wire, unch-bled.	14 00	14 00
No. 1 machine, compos'n	11 50	12 50
No. 1 compos'n turnings	10 50	9 25
No. 1 wrought iron	6 00	6 00
Heavy melting steel	5 75	6 00
No. 1 machin'y cast iron	10 50	10 50
New brass clippings	12 00	12 00
No. 1 brass turnings	10 00	10 00
Heavy lead	4 50	5 00
Tea lead	$ 3 50	$ 3 75
Scrap zinc	12 00	14 00

W. I. PIPE DISCOUNTS.

Following are Toronto jobbers' discounts on pipe in effect June 25, 1915:

	Buttweld Black	Buttweld Gal.	Lapweld Black	Lapweld Gal.
Standard				
⅛, ⅜ in.	63	32½	....	....
½ in.	68	41½	....	....
¾ to 1½ in.	73	46½	....	....
2 in.	73	46½	69	42½
2½ to 4 in.	73	46½	72	45½
4½, 5, 6 in.	....	....	70	43½
7, 8, 10 in.	....	....	67	40½
X Strong P. E.				
¼, ⅜ in.	56	32½	....	....
½ in.	63	39½	....	....
¾ to 1½ in.	67	43½	....	....
2, 2½, 3 in.	68	44½	....	....
2 in.	....	....	63	39½
2½ to 4 in.	....	....	63	42½
4½, 5, 6 in.	....	....	66	42½
7, 8 in.	....	....	59	35½
XX Strong P. E.				
½ to 2 in.	44	20½	....	....
2½ to 6 in.	....	....	43	19½
7 to 8 in.	....	....	40	16½
Genuine Wrot Iron.				
⅜ in.	57	26½	....	....
½ in.	62	35½	....	....
¾ to 1½ in.	67	40½	....	....
2 in.	67	40½	63	36½
2½, 3 in.	67	40½	66	39½
3½, 4 in.	....	....	66	39½
4½, 5, 6 in.	....	....	63	36½
7, 8 in.	....	....	60	33½

Wrought Nipples.	
4 in. and under	77½%
4½ in. and larger	72½%
4 in. and under, running thread	57½%
Standard Couplings.	
4 in. and under	60%
4½ in. and larger	40%

MILLED PRODUCTS.

Sq. & Hex. Head Cap Screws	65%
Sq. Head Set Screws	65 & 10%
Rd. & Fil. Head Cap Screws	45%
Flat & But. Head Cap Screws	40%
Finished Nuts up to 1 in.	70%
Finished Nuts over 1 in. N.	70%
Semi-Fin. Nuts up to 1 in.	70%
Semi-Fin. Nuts over 1 in.	72%
Studs	65%

METALS.

	Montreal.	Toronto.
Lake copper, carload	$21 50	$21 25
Electrolytic copper	21 25	21 00
Castings, copper	21 00	20 75
Tin	45 00	45 00
Spelter	28 00	28 00
Lead	7 50	7 25
Antimony	40 00	40 00
Aluminum	40 00	40 00

Prices per 100 lbs.

BILLETS.

	Per Gross Ton
Bessemer, billets, Pittsburgh	$20 00
Openhearth billets, Pittsburgh	20 00
Forging billets, Pittsburgh	25 00
Wire rods, Pittsburgh	25 00

NAILS AND SPIKES.

Standard steel wire nails, base	$2 40	$2 35
Cut nails	2 50	2 70
Miscellaneous wire nails	75 per cent.	
Pressed spikes, ⅝ diam., 100 lbs.	2 85	

BOLTS, NUTS AND SCREWS.

	Per Cent.
Coach and lag screws	75
Stove bolts	80
Plate washers	40
Machine bolts, ⅜ and less	70
Machine bolts, 7-16 and over	60
Blank bolts	60
Bolt ends	60
Machine screws, iron, brass	35 p.c.
Nuts, square, all sizes	4¼c per lb. off
Nuts, Hexagon, all sizes	4¾c per lb. off
Iron rivets	72½ per cent.
Boiler rivets, base, ¾-in. and larger	$3.25
Structural rivets, as above	3.25
Wood screws, flathead, bright	85, 10, 7½, 10 p.c. off
Wood screws, flathead, Brass	75 p.c. off
Wood screws, flathead, Bronze	70 p.c. off

LIST PRICES OF W. I. PIPE.

Standard. Nom. Diam.	Price. per ft.	Extra Strong, Sizes Ins.	Price per ft.	D. Ex. Strong, Size Ins.	Price per ft.
⅛in	$ .05½	⅛in	$ .12	½	$ .32
¼in	.06	¼in	.07½	¾	.35
⅜in	.06	⅜in	.07½	1	.37
½in	.08½	½in	.11	1¼	.52½
¾in	.11½	¾in	.15	1½	.65
1 in	.17½	1 in	.22	2	.91
1¼in	.23½	1½in	.30	2½	1.37
1½in	.27½	1½in	.36½	3	1.86
2 in	.37	2 in	.50½	3½	2.30
2½in	.58½	2½in	.77	4	2.76
3 in	.76½	3 in	1.03	4½	3.26
3½in	.92	3½in	1.25	5	3.86
4 in	1.09	4 in	1.50	6	5.32
4½in	1.27	4½in	1.80	7	6.35
5 in	1.48	5 in	2.08	8	7.25
6 in	1.92	6 in	2.86	....	.....
7 in	2.38	7 in	3.81	....	.....
8 in	2.50	8 in	4.34	....	.....
8 in	2.88	9 in	4.90	....	.....
9 in	3.45	10 in	5.48	....	.....
10 in	3.20	....	....	....	.....
10 in	3.50	....	....	....	.....
10 in	4.12	....	....	....	.....

COKE AND COAL.

Solvay Foundry Coke	$5.75
Connellsville Foundry Coke	4.85-5.15
Yough, Steam Lump Coal	3.83
Penn. Steam Lump Coal	3.63
Best Slack	2.99

Net ton f.o.b. Toronto.

COLD DRAWN STEEL SHAFTING.

At mill	40%
At warehouse	40%

Discounts off new list. Warehouse price at Montreal and Toronto.

MISCELLANEOUS.

Solder, half-and-half	$ 0.28
Putty, 100 lb. drums	$ 2.70
Red dry lead, 100-lb. kegs, per cwt.	9.67
Glue, French medal, per lb.	0.18
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.18
Benzine, single bbls., per gal.	0.18
Pure turpentine, single bbls.	0.66
Linseed oil, raw, single bbls.	0.73
Linseed oil, boiled, single bbls.	0.76
Plaster of Paris, per bbl.	2.50
Plumbers' Oakum, per 100 lbs.	4.00
Lead wool, per lb.	0.09
Pure Manila rope	0.16
Transmission rope, Manila	0.19½
Drilling cables, Manila	0.17½
Lard oil, per gal.	0.60

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto 40%

PROOF COIL CHAIN.

¼ inch	$8.00
5-16 inch	5.35
⅜ inch	4.60
7-16 inch	4.30
½ inch	4.05
9-16 inch	4.05
⅝ inch	3.90
¾ inch	3.85
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

TWIST DRILLS.

	%
Carbon up to 1½ in.	60
Carbon over 1½ in.	25
High Speed	40
Blacksmith	60
Bit Stock	60 and 5
Centre Drill	20
Ratchet	20
Combined drill and c.t.s.k.	15

Discounts off standard list.

REAMERS.

	%
Hand	25
Shell	25
Bit Stock	25
Bridge	65
Taper Pin	25
Centre	25
Pipe Reamers	80

Discounts off standard list.

IRON PIPE FITTINGS.

Canadian malleable, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped unions, 65.

TAPES.

Chesterman Metallic, 50 ft.	$2.00
Lufkin Metallic, 603, 50 ft.	2.00
Admiral Steel Tape, 50 ft.	2.75
Admiral Steel Tape, 100 ft.	4.45
Major Jun., Steel Tape, 50 ft.	3.50
Rival Steel Tape, 50 ft.	2.75
Rival Steel Tape, 100 ft.	4.45
Reliable Jun., Steel Tape, 50 ft.	3.50

SHEETS.

	Montreal	Toronto
Sheets, black, No. 28	$3 00	$3 00
Canada plates, dull, 52 sheets	3 10	3 50
Canada plates, all bright	4 25	4 50
Apollo brand, 10¾ oz. galvanized)	6 40	6 40
Queen's Head, 28 B.W.G.	6 50	6 50
Fleur-de-Lis, 28 B.W.G.	6 30	6 30
Gorbal's Best, No. 28	6 50	6 50
Viking metal, No. 28	6 00	6 00
Colborne Crown, No. 28	6 30	6 30

BOILER TUBES.

Size	Seamless	Lapwelded
1 in.	$10 00	.....
1¼ in.	10 00	.....
1½ in.	10 00	.....
1¾ in.	10 00	.....
2 in.	10 50	9 20
2¼ in.	12 10	.....
2½ in.	13 05	12 10
3 in.	15 75	12 70
3¼ in.	.....	13 90
3½ in.	20 00	15 00
4 in.	25 50	18 90

Prices per 100 feet, Montreal and Toronto.

BELTING—NO. 1 OAK TANNED.

Extra heavy, sgle. and dble.	50 & 10%
Standard	60%
Cut leather lacing, No. 1	$1.20
Leather in sides	1.10

ELECTRIC WELD COIL CHAIN B.B.

3-16 in.	$9.00
¼ in.	6.25
5-16 in.	4.65
⅜ in.	4.00
7-16 in.	4.00
½ in.	4.00

Prices per 100 lbs.

WASTE.

WHITE.	Cents per lb.
XXX Extra	0 10¼
X Grand	0 09¾
XLCR	0 09¼
X Empire	0 08½
X Press	0 07¾
COLORED.	
Lion	0 07⅛
Standard	0 06⅜
Popular	0 05¾
Keen	0 05¼
WOOL PACKING.	
Arrow	0 16
Axle	0 11
Anvil	0 08
Anchor	0 07
WASHED WIPERS.	
Select White	0 09
Mixed Colored	0 06¼
Dark Colored	0 05¼

This list subject to trade discount for quantity.

BELTING RUBBER.

Standard	50%
Best grades	30%

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents.

Toronto, Ont., July 20, 1915.—The industrial situation is in much the same position as last week, and no striking developments have taken place. It is, however, confidently expected that further war orders of considerable size will be placed with Canadian manufacturers. The money already expended in Canada on war equipment is enormous, and will go a long way towards making up for the loss of ordinary trade. The situation as regards the shell industry is unchanged, but considerable progress is being made towards increasing the output of cartridge cases and other shell parts necessary for making complete shells. When Canada is in a position to ship fixed ammunition entirely, orders for shells will again be distributed.

The development of foreign trade is being followed with the greatest interest in business circles, and satisfactory results are expected from the efforts that are being put forth. A good start has already been made, and the outlook is favorable for considerable business in the future.

Steel Markets.

There is a continued heavy demand for bars and forgings for shells, and the entire production of the mills is being rapidly absorbed by our various shops. Although the forging plants have con-

siderably increased their output during the last few months, it is yet hardly sufficient to meet the demand from machine shops. When larger orders for 4.5 shells come to be placed, as they will be, it will mean increased activity at the forging plants and possibly in some cases the installation of more presses.

Merchant business continues quiet, there being hardly any material improvement in the building trade. There is a fair demand for bridge sections, and some inquiries for reinforcing bars have been sent out. The steel pipe trade is comparatively quiet, although the City of Ottawa is in the market for a quantity of 51-in. pipe. Prices of steel products are holding firm.

There is no change in the galvanized sheet situation, as the trade is not inclined to buy spelter at the present price, which is too high to use for sheets. Some mills are refusing to take contracts under present conditions. Galvanized pipe is very firm.

Favorable conditions continue in the steel trade in the States, and production is increasing to keep pace with the demand. There is a heavy demand for bars for shells, and some large contracts have been made. The United States Steel Corporation has advanced quotations on bars, plates and shapes for current or third-quarter delivery to 1.30 Pittsburg.

Pig Iron.

There is no change in the situation as regards Canadian furnaces, although it is stated that a considerable tonnage of low phosphorous iron is being shipped to Eastern points in the States.

Machine Tools.

The shell business continues to occupy the attention of the machinery houses, who are still busy figuring on equipments for making shells. Although no new orders for shells have been placed recently, prospective makers are preparing to do business in anticipation of obtaining contracts later. The situation as regards deliveries of new tools does not improve, and the demand for second-hand equipments is, therefore, being stimulated.

Supplies.

The demand for machine shop supplies continues good, and is likely to continue so. Tool steel is in good demand at the advanced prices. The shortage of supplies of tungsten is causing considerable concern among tool steel makers, and the situation may be said to be acute.

Metals.

There is a weak tendency throughout the metal markets, and copper, tin and lead have all declined slightly, due in the case of the two former metals to weakness in the London market. The spelter situation is unchanged, there recently having been little demand for this metal. There is a continued scarcity of aluminum and quotations are nominal. There is no change in the antimony situation, but prices are holding firm at a dull market. Solders are weaker on account of the decline in tin. Business locally is very good in metals used in munitions, while ordinary business is also improving.

Tin.—The weakness in the London market continues, and there appears to be a lack of confidence there. In New York the market is easier all round, and, except for far-off futures, buyers show no interest. The local market has declined 1c, and tin is now quoted at 45c per pound.

Copper.—The market has declined in London, and is weak and unsettled in New York. Exports from New York have fallen off during the last two or three weeks, and against this, production has been very heavy, which has resulted in the stated weakness. Copper has declined ¼c, and is quoted at 21¼c per pound.

Spelter.—The market is weaker, but dealers are not trying to force business, and prices are unchanged. The large additions to the smelting capacity now under way will increase production, but as this will no doubt be more than consumed, lower prices for spelter are hardly likely under the prevailing conditions. Local quotations are unchanged and nominal at 28c per pound.

Lead.—The market is steadier, but there is a weak tendency. The Trust are holding the price at $5.75, New York, thereby protecting that market. The local market, however, is weaker, lead being now quoted at 7¼c per pound.

Antimony.—The market is dull and unchanged, and quotations nominal at 40c per pound.

Aluminum.—The demand still holds good and supplies are scarce. Quotations are nominal at 40c per pound.

NEW WAR ORDER DEPARTMENT.

SECURING war orders is a dominant though in the mind of the Canadian manufacturer to-day. The new arrangement made by the British War Office for the purchase of supplies in Canada is, therefore, a matter of such importance that every manufacturer should understand thoroughly the basis on which the Imperial business is to be conducted from now on. With a view to securing this information **Canadian Machinery** has spent some time investigating the new system thoroughly.

At the outset it can be taken for granted that the decision of the British War Office, to make purchases of war supplies in Canada, through the Canadian Pacific Railway, taken in conjunction with the special visit of Sir Thomas Shaugnessy to England, presumably at the request of the British Government, is an indication that the Imperial authorities are anxious to develop the facilities for war material in Canada. The appointment of Sir Thomas Shaughnessy to an office, the powers of which are indefinite, but which may be as broad as those of J. P. Morgan in the United States, and the sending out of D. A. Thomas the Welsh coal magnate as special representative of the British Department of Munitions, are evidences of the fact that the British official eye has been opened as to Canada's capacity for production. Broadly, Canada is to supply a larger share of the war supplies needed by the British Government.

The adoption of the system by which war purchases are made in Canada through the Purchasing Department of the Canadian Pacific took place some months ago. The full significance of this move did not become apparent, however, until Sir Thomas Shaughnessy was called to England. On his return, his statements indicated that he had been able to considerably extend the scope of the Purchasing Department. What special powers were granted to Sir Thomas have not been announced, but there is a general belief that they are much broader than has been officially given out. The machinery for placing orders employed by the War Office, prior to the inauguration of the new system was still in existence for the purpose of closing up the business awarded under it.

The New System.

The War Purchasing Office, as now constituted, is the development of a unit of the Purchasing Department employed by the Canadian Pacific Railway; and the internal machinery for the most part will be the same. That the C. P. R. purchasing system is efficient was demonstrated recently when the city of New York decided to model the Civic Purchasing Department on the same lines. The department has been located at 114 Windsor street, Montreal, on the Windsor street level of the Canadian Pacific Railway depot. The chief of the department is E. FitzGerald, who has been connected with the C. P. R. Purchasing Department for the past 20 odd years. Although assisted by a large and capable staff, the orders will be placed through Mr. FitzGerald, and all communications should be addressed to him.

Tentative Requisitions Supplied.

The methods employed are along the same lines as adopted in the C. P. R. The first step is when a tentative requisition is received from the War Office. This is not a definite order, but a general inquiry as to what the Department can

do in Canada to supply certain goods. Price and date of delivery are both important factors, as it is likely that in all cases there may be other sources of supply receiving competitive consideration at the War Office. Canada, as a colony of the Empire, will be entitled to some special concessions, but it cannot be expected that unreasonable allowances will be made.

The Canadian Purchasing Department, with the general information as to what the War Office needs, then goes to the Canadian manufacturers, and in some cases to jobbers, when there may not be time or opportunity for manufacture, asking for information as to what quantity could be produced and at what price. When prices and particulars are received, they are submitted to the War Office. It is not until the definite order is placed that it is known whether Canada is to get the business or not.

This, in brief, is the system which will be followed. The opinion has been expressed in many quarters that a more satisfactory method would be to make public the particulars as to the requirements of the War Office, thus giving all manufacturers a chance to apply for a share of business. This suggestion was broached by representative of **Canadian Machinery** to Mr. FitzGerald, but it was found that the Department would not consider this form of procedure. The reason for not adopting this plan is that the announcement of large requirements in any certain line would have the inevitable effect of stiffening the price of raw materials. Thus, the cost to the War Office would in the end be increased; and one principle on which the orders are now being placed is that the lowest possible cost, compatible with the essential quality and a fair profit to the maker, must be secured. It was pointed out also that from the standpoint of the Canadian manufacturer high prices were to be avoided for the reason that they would have the effect of turning the orders from Canada altogether. The system of publicly announcing the requirements would be possible if the Purchasing Department were given carte blanche as to price; an unlikely development except perhaps in emergencies.

Thus the system to be followed is as stated above. Some will disapprove of this system, but the fact remains that it is on this basis that the Department will work and the manufacturer who expects to get business must fall into line and make the best of the situation.

What Manufacturers Must Do.

The Purchasing Department claim that they have very complete information as to the manufacturers in each line. They have on file the trade papers of the Dominion and the Manufacturers' Directories published by the Department of Trade and Commerce and the Canadian Manufacturers' Association. It is the earnest object of the Department now, on receiving information of requirements, to communicate with every manufacturer in the Dominion in a position to handle some share of the business. It is in this connection that the individual responsibility of the manufacturer comes into play. Manufacturers or groups of manufacturers who consider that they are in a position to supply from present stock or to produce articles for supplies—anything that might be required by the War Office from shells to canned goods—at prices which would be satisfactory, should lose no time in getting into communication with the C. P. R. War Purchasing Department, so that there can be no question as to their complete possibilities being known to the Department. The War Office may have an accurate line on the capacity of each manufacturing plant in Canada and the stock each manufacturer is carrying at present, but no manufacturer should take this for granted. Give complete information to the Department now. Jobbers in a position to give a close price on stock lines for which there is a strong demand would also be in line for this business.

Many manufacturers have already put themselves in touch with the War Purchasing Office. All others should do so without any delay.

In this way the new system will be made efficiently operative from all standpoints.

Nor is it the intention of the Department, according to Mr. FitzGerald, to give out information concerning orders which have been placed. This, he contends, leads to dissatisfaction in some cases, and to higher quotations for future requisitions in others. This phase of the situation emphasizes still further the importance of each manufacturer keeping closely in touch with Mr. FitzGerald's department. It may be stated, however, that among the articles which have already been purchased through the new Department are: Nails, matches, miscellaneous tools, steel forges, helmets and steel wire rope. Further, it may be stated that at the present time there are a number of substantial orders in the tentative stage. Perhaps **you** are in a position to supply some of the material covered in these orders pending. Make your capacity known.

Extending Scope of Orders.

However, dealing with the requisitions as they are received from the War Office is only one phase of the word of the purchasing department. There is another, which is in a sense even more important, and that is in bringing to

A WORD TO MANUFACTURERS.

Every manufacturer in Canada who is turning out a product which classifies with any of the articles which have already been purchased for the needs of the armies of the Empire, or who believes that he is making or could make an article which could be put to such use—at a fair competitive price—should communicate with the new purchasing department established in Canada by the British War Office in conjunction with the Canadian Pacific Railway. Such information will be used whenever possible to extend the field of purchasing in the Dominion. All manufacturers who are seeking war orders should make sure that their names are on the lists of the purchasing department of the C. P. R. or the new war order branch thereof recently established.

Jobbers may also be in a position to figure on certain lines of supplies when manufacturers cannot meet the requirements readily, but it would appear to be the intention to figure prices closely.

Address,
E. FITZGERALD,
War Purchasing Department, C.P.R.,
Windsor Street, Montreal.

the attention of the Department the possibilities of Canadian industry in relation to the needs of the British forces. It is in this connection that the visit of Sir Thomas Shaughnessy to England takes special significance.

Mr. Fitzgerald is in regular communication with the War Office. Information is being constantly sent forward as to supplies which can be readily secured. Manufacturers individually must strengthen his hand in this regard.

Mr. Fitzgerald was asked as to whether any steps were being taken to secure supplies of raw material to make up orders—as, for instance, cloth for uniforms. His reply was that, so far as he knew, nothing was being done. Canadian manufacturers will have to stand on their own feet in securing raw material. It is not the intention of the Purchasing Department to assist in this respect.

The scope of the C. P. R. War Purchasing Department in placing orders has not been clearly defined. It does not include shells—the shell situation will be dealt with in a later article—and it is officially reported not to include other munitions, but this seems likely to be altered. The Department has wider powers apparently than have yet been announced.

AMERICAN ENGINES FOR BRITISH PATROL LAUNCHES

The Sterling Engine Company, Buffalo, N.Y., manufacturer of motor boat engines, has shipped to London one 250-h.p. 8-cylinder engine, one 100-h.p. six-cylinder engine, and one 50-h.p. four-cylinder engine for motor boat control launches, and submarine destroyers for the British Government. These motor boats are to have a seagoing speed of upward of 30 miles per hour. It is stated large orders for motor engines are to follow. The company has two 300-hp. 8-cylinder engines completed and under test nearly ready for shipment. It has also an order just received for six 150-hp. 6-cylinder engines and one for four 200-h.p. motor boat engines for the Italian Government to cost $12,000.

The Turbine Equipment Co., Toronto, have sold two 750 k.w. non-condensing steam turbine-driven alternators to the Aetna Explosives Co., Montreal, Que.

M. Beatty & Sons, Ltd., Welland, Ont., announce that the control and management of the company has been changed. H. L. Beatty has been elected president, and A. O. Beatty, vice-president and general manager. Harris T. Dunbar, of Buffalo, has been elected a member of the board of directors. V. R. Browning, B. F. Miles, directors, and R. A. Greene, general manager, who have had charge of the business for the past three years, have severed their connection with the company.

CANADIAN COMMERCIAL INTELLIGENCE SERVICE

The Department of Trade and Commerce invites correspondence from Canadian exporters or importers upon all trade matters. Canadian Trade Comissioners and Commercial Agents should be kept supplied with catalogues, price lists discount rates, etc., and the names and addresses of trade representatives by Canadian exporters. Catalogues should state whether prices are at factory point, f.o.b. at port of shipment, or, which is preferable, c.i.f. at foreign port.

CANADIAN TRADE COMMISSIONERS.

Argentine Republic.

H. R. Poussette, 278 Balcarce, Buenos Aires. Cable Address, Canadian.

Australasia.

D. H. Ross, Stock Exchange Building, Melbourne, Cable address, Canadian.

British West Indies.

E. H. S. Flood, Bridgetown, Barbadoes, agent also for the Bermudas and British Guiana. Cable address, Canadian.

China.

J. W. Ross, 6 Kiukiang Road, Shanghai. Cable Address Cancoma.

Cuba.

Acting Trade Commissioner, Lonja del Comercio, Apartado 1290, Havana. Cable address, Cantracom.

France.

Phillipe Roy, Commissioner General, 17 and 19 Boulevard des Capucines, Paris. Cable address, Stadacona

Japan.

G B Johnson, P.O Box 109, Yokohama. Cable Address, Canadian.

Holland.

J T. Lithgow, Zuidblaak, 26, Rotterdam. Cable address, Watermill.

Newfoundland.

W. B. Nicholson, Bank of Montreal Building, Water Street, St. John's. Cable address, Canadian.

New Zealand.

W. A. Beddoe, Union Buildings, Customs Street, Auckland. Cable address, Canadian.

South Africa.

W. J. Egan, Norwich Union Buildings, Cape Town. Cable address, Cantracom.

United Kingdom.

E. de B. Arnaud, Sun Building, Clare Street, Bristol. Cable address, Canadian.

J. E. Ray, Central House, Birmingham. Cable address, Canadian.

Acting Trade Commissioner, North British Building East Parade, Leeds. Cable address, Canadian.

F. A. C. Bickerdike, Canada Chambers, 36 Spring Gardens, Manchester. Cable address, Cantracom.

Fred. Dane, 87 Union Street, Glasgow, Scotland. Cable address, Cantracom.

Harrison Watson, 73 Basinghall Street, London, E.C., England. Cable address, Sleighing, London.

CANADIAN COMMERCIAL AGENTS.

British West Indies.

Edgar Tripp, Port of Spain, Trinidad. Cable address, Canadian.

R. H. Curry, Nassau, Bahamas.

Colombia.

A. E. Beckwith, c-o Tracey Hmos, Medellin, Colombia. Cables to Marmato, Colombia. Cable address, Canadian.

Norway and Denmark.

C. E Sontum, Grubbegd No. 4, Christiana, Norway. Cable address, Sontums

South Africa.

D. M. McKibbin, Parker, Wood & Co., Buildings, P.O. Box 559, Johannesburg.

E. J. Wilkinson, Durban, 41 St. Andrew's Buildings, Durban, Natal

CANADIAN HIGH COMMISSIONER'S OFFICE.

United Kingdom.

W. L. Griffith, Secretary, 17 Victoria Street, London, S.W., England.

THE A. R. WILLIAMS MACHINERY CO., LTD.
ST. JOHN, N.B. TORONTO WINNIPEG VANCOUVER
Canada's Leading Machinery House

Are You Going To Make Projectiles?

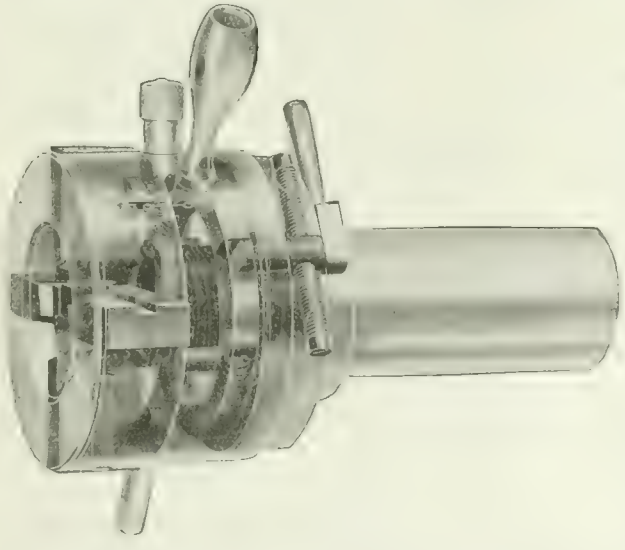
You will be interested to know that our Service Department,—organized specially to take care of your requirements,—can give you all the information on the most up-to-date methods used in the manufacture of Shrapnel and High Explosives.

Don't worry about the recent order closing manufacturers' shops to public inspection. Come and see us and bring your problems along.

This is the time when Service Counts—Write Us.

THE A. R. WILLIAMS MACHINERY COMPANY, LIMITED
TORONTO, ONTARIO

MADE WHERE? NO. HOW?
THAT IS IT—HOW ARE THEY MADE



Note phantom view of the Geometric Style "D" Die Head. Everything is there—micrometer adjustment, roughing and finishing attachment (chasers automatically opened) closing handle. Length of thread accurately governed—short or long, and run right up to shoulder if required. Arranged for cutting any diameter, pitch and form of thread.

Perfected in all its working parts, you will find the Geometric in good live shops, on Hand and Automatic Screw Machines.

Let us recommend the right sort of Die Head for your work.

The Geometric Tool Company, New Haven, Conn., U.S.A.

CANADIAN AGENTS:

Williams & Wilson, Limited, Montreal. The A. R. Williams Machinery Co., Limited, Toronto, Winnipeg, St. John, N.B.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

INDUSTRIAL AND CONSTRUCTION NEWS

Establishment or Enlargement of Factories, Mills, Power Plants, Etc.; Construction of Railways, Bridges, Etc.; Municipal Undertakings; Mining News.

Engineering

Preston, Ont.—The Dominion Bronze Co. have started work on a large order for brass sockets for shells.

Bathurst, N.B.—The town will build a power house, boiler-room and pumping station. John G. Staut is town clerk.

Blenheim, Ont.—The School Board have decided to install a new heating system in the school to cost $2,500. R. L. Gosnell is chairman of the Board.

North Vancouver, B. C.—The Wallace Shipyards and North Shore Iron Works have their plants in readiness to start on the Imperial Government shell order.

Berlin, Ont.—The Water Commission has decided to purchase eight new 3-in. pumps and motors at a cost of $179 each. These will be used on the wells in place of the air-forcing system.

Hamilton, Ont.—The E. T. Wright Co., manufacturers of tinware are considering making a large addition to their factory. An enameling and aluminium plant will be included in the extension.

Thorold, Ont.—The laboratory building, on the premises of the Coniagas Reduction Co., about a mile east of Thorold, was destroyed by fire, together with its contents, on July 13. The loss is estimated at $10,000 which is covered by insurance.

St. Marys, Ont.—The firm of Weir & Weir, have advertised for a site in Stratford suitable for a mill. They claim that the Hydro rates in St. Marys are too high, that they cannot compete with waterpower, and in Stratford their competition would be steampower.

Niagara Falls, Ont.—Work on the construction of an aerial tramway over the Whirlpool has been started by the McLeod Contracting Co. of Toronto. The tramway is being constructed by the Spanish-American Tramway Co., a subsidary of a big Spanish amusement concern.

Municipal

Winnipeg, Man.—The city are considering a proposition for laying 12 miles of gas mains.

Sackville, N.S.—The Town Council have decided to purchase a pump and motor for the waterworks plant.

Rodney, Ont.—A by-law will be voted on by the ratepayers on July 26, to authorize the granting of a loan of $5,000 to the Rodney Woodware Co.

Chatham, Ont.—The city council have recommended the purchase of an aerial truck for the fire department at a cost of about $13,500. A by-law will be voted on.

Exeter, Ont.—By a vote of 247 to 7, the ratepayers of Exeter on July 16 endorsed a Hydro power by-law. The vote calls for the installation of a Hydro-Electric system here, at a cost of $20,000.

Petrolea, Ont.—Petrolea joined the hydro-electric union on July 14, by carrying with a majority of 385 to 10 a by-law calling for the expenditure of $35,000 for the installation of the hydro system. The contract calls for an initial consumption of 500 horse-power at $36.25 per horse-power per annum.

Ottawa, Ont.—The proposed Lemieux Island waterworks scheme includes the trenching and laying of 14,000 lineal feet of 51 in. diameter steel pipe, also the construction of a 4-span concrete bridge. The pumping plant will consist of three motor-driven centrifugal pumps, each having a capacity of twenty million Imperial gallons against a head of 280 feet. Tenders are being called for the above.

General Industrial

Hamilton, Ont.—Work has begun on the excavation for the factory of the T. Eaton Co., of Toronto.

Redcliff, Alta.—D. Broadfoot is endeavoring to make arrangements for the construction of an elevator here.

Collingwood, Ont.—The Bryan Mfg. Co. are asking a loan of $20,000 to assist in the building of a woodenware factory.

Latchford, Ont.—The Canadian Pulp & Lumber Co.'s mill has been destroyed by fire. The loss is estimated at about $50,000.

Aylmer, Que.—An option has been secured on 15 acres of land here for the erection of a sugar factory. D. A. Gordon, of the Dominion Sugar Co., Wallaceburg, Ont., is interested. It is understood that the plant will cost $400,000.

Vancouver, B. C.—H. T. Graham of Belleville, Ont. has purchased the Scottish-Canadian Cannery at Steveston. The plant will be renovated and new machinery installed for handling this season's catch.

Guelph, Ont.—An elevator will be installed at the gas works for unloading coal from the cars. It is also proposed to install a new gas holder next year. The Light and Heat Commission have the matter in hand.

Tenders

Ottawa, Ont.—Tenders on the supply of transformers, switches, and equipment will be received until August 3 by the chairman of the Waterworks Commission. Plans and specifications with the city engineer, R. L. Haycock.

Toronto, Ont.—Tenders will be received up to Tuesday, August 3rd, 1915, for the supply of—58 Tie Rods and Tie plates for Lansdowne Avenue Extension, Toronto Civic Railway. Specifications and forms of tender may be obtained at the Works Department, City Hall.

Winnipeg, Man.—Tenders will be received until Monday, July 26, 1915, for the supply of two 50-light, high efficiency incandescent Street Lighting Equipments, complete with lamps. Instructions to bidders, specifications and form of tender may be obtained at the office of the City Light and Power Department, 54 King Street.

Toronto, Ont.—Tenders will be received until Monday, July 26, 1915, for enlargement Manning Avenue School; new building Manual Training and Domestic Science Departments, King Edward School; iron fence, iron stairs, concrete floors, electrical work, local telephones, and midsummer repairs at sundry schools. Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto.

Oakville, Ont.—Tenders will be received by the chairman of the Oakville Water and Light Commission until Monday, July 26, 1915, for furnishing and installing one electrically-operated turbine pump of 600 Imperial gallons capacity against a head of 300 feet. Specifications may be seen at the office of the

Rebuilt Machine Tools

will serve your purpose just as well as new machinery after they have passed through our hands. We guarantee them complete and ready for operation when received by our customers, and at a **very great saving in price.**

We specialize in machine and iron-working tools, and are now supplying a number of Canadian manufacturers with **Turret Lathes, Engine Lathes** and other machinery suitable for the

Manufacture of Shells

Our service is based on a fair and square margin of profit, with satisfaction assured as the primary object.

If you are needing equipment it will be to your advantage to get in touch with us. Our stock is large, and if we cannot supply you from it we will take your order for future delivery, specifying a definite time when we will supply you with such tools as you may require.

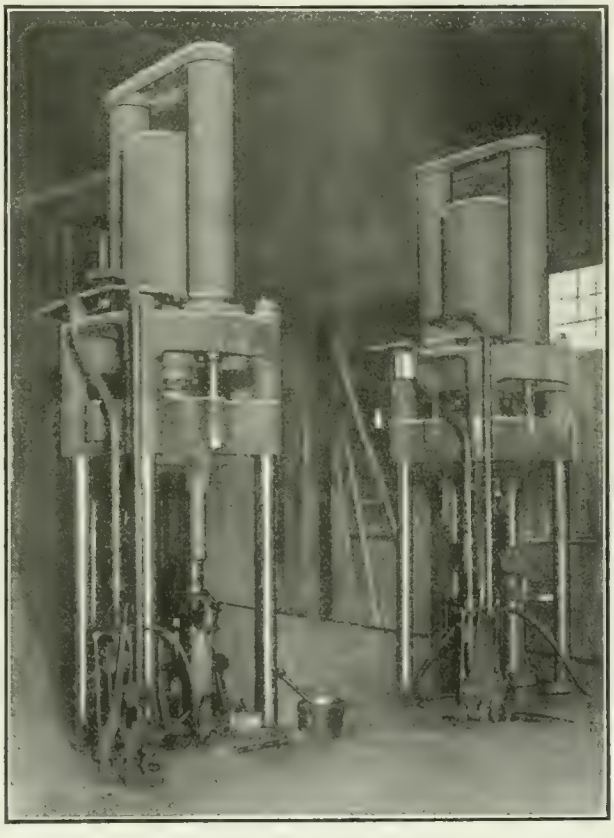
New York Machinery Exchange

50 Church Street New York

HYDRAULIC PRESSES

FOR

Shell Manufacturing



DRAWING PRESSES

WE ARE MAKING

Hydraulic Presses

For Piercing and Drawing

Shells and Projectiles

AND ARE IN A POSITION TO GIVE

PROMPT DELIVERY.

The William Cramp & Sons Ship and Engine Building Company

PHILADELPHIA, PA.

Rumely-Wachs Machinery Co.

121 N. JEFFERSON ST.

CHICAGO ILLINOIS

New and second-hand machine tools in stock for immediate delivery:

LATHES

18" (20" swing) x 8' Hamilton, C.R. H.S. (Used).
18" x 10' Rahn Carpenter, C.R. H.S. (Used).
21" x 10' Bradford, C.R. H.S. (Used).
22" x 12' Flather, C.R. H.S. (Used).
24" x 8' Putnam (Used).
24" x 8' Sherman (Used).
25" x 14' LeBlond, heavy duty (New).
30" x 14' American (Used).
36" x 12' Schumacher & Boye (Used).
36" x 16' Fifield (Used).

TURRET LATHES and SCREW MACHINES

Two 24" Morse Turret Lathes, with 1" hex. turret, on carriage (Used).
No. 5 Bardons & Oliver (2") with wire feed, oil pump and pan (Used).
Two Bardons & Oliver No. 2 Hand Screw Machines, plain head, (1") wire feed, oil pump and pan (Used).

PLANERS

30" x 30" x 8' Flather, one head (Used).
36" x 36" x 8' American, two heads (Used).
36" x 36" x 15' Woodward & Powell Frog and Switch, two heads (Used).

SHAPERS

20" Gould & Eberhardt, back-geared, crank (Used).
16" Stockbridge crank (Used).
14" Acme, crank (Used).

DRILL PRESSES

21" Cincinnati, B.G. and power feed (Used).
21" Hoefer, b.g. power feed (Used).
22½" Barnes, b.g. power feed (Used).
24" Cincinnati, sliding head, complete (Used).
28" Sibley & Ware, sliding head, complete (Used).
28" Barnes, sliding head, complete.
28" Sibley & Ware, sliding head, complete (Used).
31" Barnes, sliding head, complete (Used).
4½' Bickford Plain Radial (Used).
5' Prentice Plain Radial (Used).

MILLING MACHINES

No. 2 Brown & Sharpe, plain (Used).
No. 2 Kempsmith, plain (Used).
No. 2-H Brown & Sharpe, plain (Used).
No. 3 Pratt & Whitney, plain (Used).
No. 3 Kempsmith, plain (Used).
No. 3 Cincinnati, plain (Used).
No. 3 Newton, plain (Used).
No. 3 Owen, Universal (Used).

MISCELLANEOUS

No. 22 Espen-Lucas Cold Saw, capacity 6" (Used).
No. 15 Lea Simplex Cold Saw, capacity 5" (Used).
42" Colburn Boring Mill, 2 heads (Used).
42" Bullard Boring Mill, 2 heads (Used).
30" Bullard Boring Mill, one turret head (Used).
1½" Acme Bolt Cutter (Used).
2½" Acme Bolt Cutter (Used).

Commissioners, Oakville, or at the office of Chipman & Power, engineers, Mail Building, Toronto.

Personal

A. F. Macallum, city engineer of Hamilton, Ont., has volunteered for active service.

Robert G. Allan, son of one of the founders of the Allan Line, and cousin of Sir Montague Allan, died in London, England, on July 15.

Lieut-Colonel Thomas Cantley has been elected president of the Nova Scotia Steel & Coal Co. He will also retain the position of general manager.

Joseph Austin Holmes, director of the Bureau of Mines Department of the Interior, Washington, D.C., died at Denver, Co., on July 13.

John Palmer, managing director of the Palmer-McClellan shoe factory of Fredericton, N. B., died on July 13, from paralysis. He was 64 years old and had twice been mayor of Fredericton.

J. J. Callaham of the Montreal and Southern Counties Railway, Montreal, Que., has been appointed operating manager of the London and Port Stanley Railway with headquarters at London, Ont.

Aubrey C. White, for over thirty years Deputy Minister in the Department of Lands, Forests and Mines, for the Province of Ontario and a very prominent free-mason, died on July 14 at his summer home in Muskoka, where he had gone for a rest. He was 69 years of age.

J. H. Sherrard, of Montreal, president of the Canadian Manufacturers' Association, is touring the west in furtherance of the project of forming an Exporters' Association to organize the export trade of Canada under the changed conditions caused by the war.

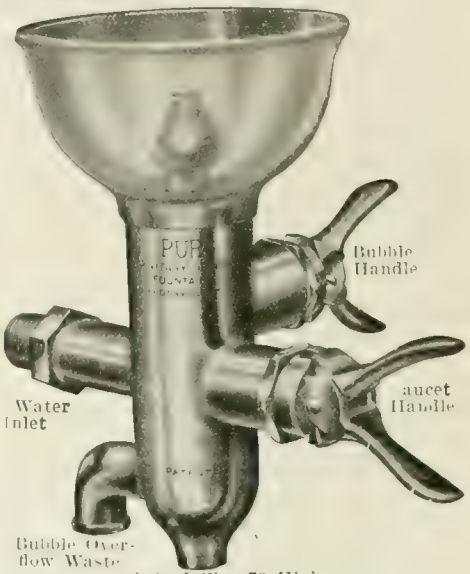
William T. Dunn, formerly tool steel expert for the Carpenter Steel Co. in Boston and New England, has been appointed by the International High Speed Steel Co. of New York district sales agent for New England and Eastern Canada. Mr. Dunn is at present taking a trip through the Cobalt and Porcupine district.

W. H. Westman, president of the Chatham, Ont., Board of Trade, has returned from a business trip to Chicago and points in the south in quest of new industries to locate factories in Chatham. Mr. Westman is in close touch with a number of companies on the other side that may later decide to locate Canadian branches.

PURO

(MADE IN CANADA)

Don't Pay Good Money for Impractical, Unmechanical and Often Worthless Fountains



Actual Size 7" High.

Here is a practical Fountain, which combines the Faucet and Bubble Features takes care of the overflow waste, and insures

Safety and Service

This is an age of sanitary plumbing and the Sanitary Drinking Fountain is one of its important subdivisions.

SAFETY FIRST **PURO** SERVICE ALWAYS

Is made of heavy brass with extra heavy nickel plate. Bubbler easily controlled by separate "squeeze" handle. No spurts—no choking—inside regulation prevents "showerbath." Faucet is controlled by another squeeze handle. Faucet gives full water pressure. Has thread for hose if wanted.

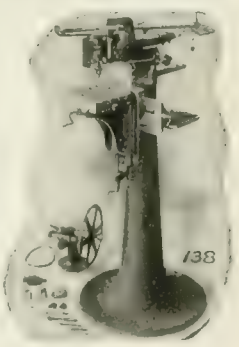
Write us the number of your employes and water pressure and we'll present an interesting proposition to you promptly.

Puro Sanitary Drinking Fountain Company

147 University Ave., TORONTO, CAN.

Make Your Own Engravings

It doesn't take an expert to operate the GORTON ENGRAVING MACHINE. The ordinary workman can turn out lettering or designs either sunk or in relief, on dies, moulds, tools, patterns, core boxes, label plates, instruments, etc., etc., better than the most skilled hand engraver in the fraction of time the hand workman would take.

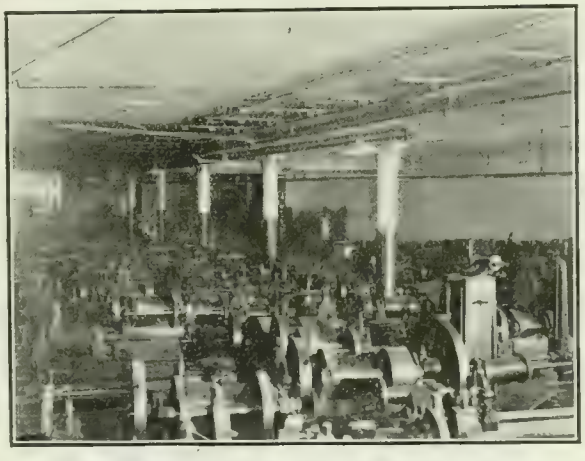


WRITE FOR DETAILS.

Geo. Gorton Machine Co.

RACINE, WIS.

MACHINE TOOLS FOR
IMMEDIATE SHIPMENT



LARGE STOCK

ENGINE LATHES

UPRIGHT AND RADIAL DRILLS

VERTICAL BORING MACHINES

HORIZONTAL BORING MACHINES

SHAPERS

PLANERS

MILLERS AND GEAR CUTTERS

HAND TURRET AND SCREW MACHINES

AUTOMATIC TURRET AND SCREW MACHINES

AUTOMATIC CHUCKING MACHINES

BUFFERS AND GRINDERS

PLAIN AND UNIVERSAL GRINDERS

PUNCH PRESSES

METAL SAWS AND CUT-OFF MACHINES

PRATT & WHITNEY RIFLE BARREL DRILLING MACHINES

WHICH DO YOU NEED?

HILL, CLARKE & CO. OF CHICAGO

125 N. CANAL STREET, CHICAGO

METAL STAMPINGS

We are manufacturers of stamped parts for other manufacturers.

We do any kind of sheet metal stamping that you require. Our improved presses and plating plant enable us to produce the finest quality of work in a surprisingly short time.

We can finish steel stamping in Nickel, Brass or Copper.

Send us a sample order.

W. H. BANFIELD & SONS
120 Adelaide St. W., Toronto

Kindly mention this paper when writing to advertisers.

PATENT ATTORNEYS

PATENTS W. T. Cuffe-Quin
Patent Solicitor and Expert
Registered Patent Attorney, U.S. 9187
Fellow Surveyors Institute, London, England
47 Central Chambers, Elgin Street,
OTTAWA, CANADA Near Govt. Patent Office.
Associate work for the Legal Profession before the Government Patent Office, a specialty
Cable address "Cquin Ottawa."

PATENTS PROMPTLY SECURED
In all countries. Ask for our Inventor's Adviser, which will be sent free.
MARION & MARION, 364 University St.
Merchants Bank Building, corner St. Catherine St., MONTREAL, Phone Up 6474 and Washington, D.C., U.S.A.

PATENTS TRADEMARKS AND DESIGNS
PROCURED IN ALL COUNTRIES
Special Attention given to Patent Litigation
Pamphlet sent free on application.
RIDOUT & MAYBEE 59 Yonge Street
TORONTO

Morton Manufacturing Co.
Draw Cut Shapers, Special Draw Cut R.R Shapers, Special Locomotive Cylinder Planers.
Portable Planers, Stationary & Portable Key Way Cutters, Finished Machine Keys.
Office & Works, Muskegon Heights, U.S.A.

IMMEDIATE DELIVERY

400 or more modern machines in stock for the manufacture of

Shell and Fuse Parts
and General Manufacturing Purposes

We solicit inquiries requiring prompt deliveries.

Girard Machine and Tool Co.
491-493 N. Third Street, Philadelphia, Pa.

Trade Gossip

The Hamilton Facing Mill Co., Hamilton, Ont., have increased their capital stock to $75,000.

Port Credit, Ont.—A Board of Trade has been formed here. W. C. C. Innes is the president.

The Beaver Asbestos Co., have changed their name to that of the Windsor Asbestos Co.

The Canadian Cartridge Co., Hamilton, Ont., has been authorized to increase its capital stock to $150,000.

Guelph, Ont.—It is announced that the Page-Hersey Iron and Tube Co. will resume operations at their plant here in a week or two.

The Rica-Wil Underground Pipe Covering Co., have obtained a license to manufacture pipes and pipe coverings in the Province of Ontario.

P. Lyall & Son Construction Co., Ltd. of Montreal, have obtained an extension of powers to permit them to engage in the manufacture of shells, guns and other munitions.

Montreal, Que.—The plant of the Montreal Technical School will be used for turning out certain lathe attachments and apparatus required for the manufacture of shells. A. Macheras is principal of the school.

The Polson Iron Works, Toronto, have applied to the City Architect's department for permission to make another small addition to their building for the purpose of manufacturing shells.

Catalogues

Gaskets—The Niagara Falls Gasket & Packing Co., Niagara Falls, Ont., has issued a leaflet dealing with their line of metal asbestos gaskets and the Ames alloy metallic sheet packing.

Steel Castings the product of foundries at Windsor, Ont., and Detroit, Mich., are illustrated and described in a catalogue recently issued by the Swedish Crucible Co. The special "Pyro" brand steel castings are included among the others, and in this connection are a few suggestions for successful carbonizing practice.

Frankfort Furnaces made by the strong, Carlisle & Hammond Co., Cleveland, Ohio. Catalogue No. 7 describes the various types of 'Frankfort' furnaces and states for what work each is specially adapted. Tables are included giving dimensions and other particulars for each size, while the concluding pages are devoted to various types of oil and gas burners, tanks, pyrometers, melting pots, etc.

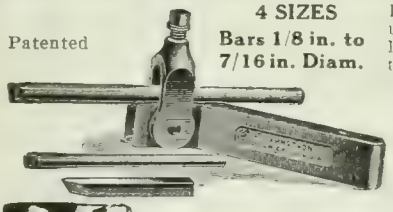
HINTS TO BUYERS

FOR SMALL, LIGHT BORING

and inside thread cutting on the Lathe, there is no tool made that will beat this

ARMSTRONG BORING TOOL HOLDER

Patented



4 SIZES
Bars 1/8 in. to 7/16 in. Diam.

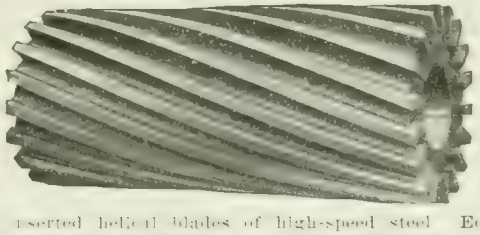
It is reversible and can be used as either right or left-hand offset tool for turning.

Our complete line is on exhibition in Block 41, Palace of Machinery, Panama-Pacific Exposition, San Francisco.

Catalog for the Asking

Armstrong Bros. Tool Co.
"The Tool Holder People"
306 N. Francisco Ave., CHICAGO, U.S.A.

Taylor-Newbold Milling Cutters



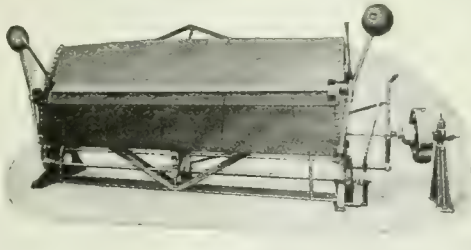
with inserted helical blades of high-speed steel. Economical, powerful and efficient. Made in 4" diameter, 4", 6", 8" and 12" lengths for general machine shop use.

Send for Bulletin R-P and 30-day Trial Offer.

THE TABOR MANUFACTURING COMPANY
PHILADELPHIA, PA., U.S.A.

Chicago Steel Bending Brakes

We are exclusive Manufacturers of Steel Bending Brakes, and our product shows it.



Only about three horse-power is required to operate this brake full capacity.

Catalog giving full description mailed upon request.

10 ft. for 10 Ga.

The Steel Bending Brake Works, Ltd., Chatham, Ontario

Danger Eliminated

The Allen Safety Set Screw eliminates all danger of accident from revolving set screws by removing the cause — the projecting screw head. It gives perfect safety, service and satisfaction without interfering with the efficiency of your men.

Write for Circular No. 3

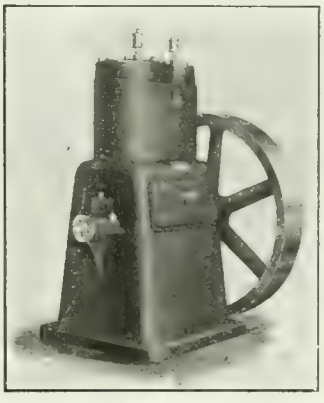
ALLEN MANUFACTURING CO., INC.
Hartford, Conn., U.S.A.
ENGLAND, 173 PRINCESS ST., MANCHESTER.

Genuine Armstrong Stocks and Dies

Hinged Pipe Vises.
Pipe Cutters. Steam and Gas Fitters' Tools.
Pipe Machines for Threading Pipe.
Either Hand or Power.

Manufactured by

THE ARMSTRONG M'F'G CO.
328 KNOWLTON ST. BRIDGEPORT, CONN.
NEW YORK, 248 CANAL ST.



IT WILL PAY YOU

to investigate our lines of

AIR COMPRESSORS

and

FOOT VALVES

Hamilton Motor Works
Limited
HAMILTON, CANADA

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

GEARS

CUT GEARS

HAMILTON

GEAR & MACHINE CO.

Cor. Concord & Van Horne

TORONTO

ACCURACY in CUTTING
makes SILENT POWER

IS YOUR RIVETING PROFITABLY DONE?

Our Elastic Rotary Blow Riveting Machine does profitable work, because one machine will do the work of several hand riveters, and do it better.

Every head is perfectly formed, any shape, round, flat, oval, rectangular, etc.

Catalogue C tells more about it.

The F. B. SHUSTER COMPANY
New Haven, Conn.
Formerly John Adt & Son. Established 1866

Also makers of Wire Straighteners and Cutter, Cotter Pin Machines, etc.

The Garvin Machine Co.

Manufacturers of

Milling Machines; Profiling Machines; Cam Cutting Machines; Screw Machines; Monitor Lathes; Die Slotting Machines; Screw Slotters; Tapping Machines; Duplex Horizontal Drills; Gang Drill Presses; Four-Head Right-Angle Drills; Wrenchless Chucks; Spring Coilers; Cutter Grinding Machines; Surface Grinders; Hole Grinders; Hand Lathes and Special Machinery.

We Want All To Have Our Catalog—Send For It To-day.

Spring and Varick Streets, NEW YORK CITY

J.C.McLAREN BELTING

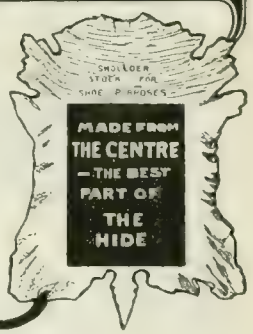
THE J.C. McLAREN BELTING CO. OAK EXTRA TANNED EST 1856

Will Save You Money In Every Day of Service

Modern plant and thorough knowledge of requirements of belting guarantees perfect satisfaction to all buyers. Our belts are the result of using best leather, and our 57 year's experience.

Ask for Quotations.

J. C. McLAREN BELTING CO.
Limited
Montreal Toronto Winnipeg



THE DUPONT

Patent

Power Hammer

BEST FOR Durability, Economy of Power, Simplicity of Adjustment.

Seven Sizes
from 35 to 300 lbs.

Only High-Class Material Used and Satisfaction Guaranteed.

ASK FOR CATALOGUE.
SENT FREE

The PLESSISVILLE FOUNDRY
Plessisville, Que.

Ontario and Western Agents:
The General Supply Co. of Canada Ltd.
Ottawa Toronto Winnipeg

PRESSES—ALL TYPES

Press Attachments, Automatic.
Metal and Wire Forming Machines.
Tumblers—Large Line.
Burnishing Machines. Grinders.
Special Machines.

Baird Machine Co., Bridgeport, Conn.

Detective and Stop Watch Combined.

"We have a counter on every one of our presses, even the foot presses." This from a satisfied user of our counters. If you use presses our counters would save you money. Ask for catalog 25.

The C. J. ROOT CO., 125 Bridge Street, Bristol, Conn.

PERFORATED METALS

XL

Write to us regarding your Tool Room partition problems. We can save you space and light.

We make any size perforation in any kind of metal required.

Canada Wire & Iron Goods Co., Hamilton

We also manufacture—

Wire Cloth for all purposes
Concrete Reinforcement
Molders' Riddles and Bellows
Metal Clothes Lockers
Steel Factory Stools
Window Guards
Ornamental Wire and Iron Work.

Toronto Testing Laboratory
LIMITED
METALLURGISTS—CHEMISTS—FUEL ENGINEERS
160 Bay St., Toronto.

Tests of Metals, Fuels, Oils, Water, Etc.
SPECIAL ATTENTION TO ALL SHELL MATERIALS

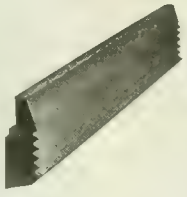
20 TIMES THE SERVICE

That's what this self-hardening, high-speed steel chaser does for the LANDIS DIE.

Four long cutters tangentially disposed to the work carried in suitable holders make an ideal cutting condition. This, along with its many other distinctive characteristics, has established for us a world-wide reputation.

WRITE FOR CATALOGUE NO. 21.

Landis Machine Co., Waynesboro, Pa.
Exclusive Canadian Representatives,
Williams & Wilson, Montreal, Canada.



NORTON JACKS
For all kinds of heavy lifting
Send for complete catalogue showing 50 styles
10 to 100 tons capacity.
Made only by
A. O. NORTON, LIMITED
Coaticook, Prov. Quebec - - Canada

PULLEYS
ALL WOOD—COMBINATION—IRON—STEEL
Every pulley fully guaranteed.
Write for interesting printed matter.
The Positive Clutch & Pulley Works, Ltd.
Montreal Factory: Aurora, Ont. Toronto

LEVIATHAN AND ANACONDA
ELEVATING
TRANSMITTING
CONVEYING
BELTING

"THE REAL REASON"
for buying a
Leviathan or Anaconda Belt

means more dollars saved to you than you can ever pay us.

Your inquiry insures our proving this.

Quick deliveries.

Let us help you solve your belting troubles.

MAIN BELTING COMPANY OF CANADA LIMITED
10½ St. Peter St., Montreal

WATCH FOR OUR MESSAGE IN NEXT WEEK'S ISSUE.

The man who does not advertise simply because his grandfather did not should wear knee breeches and a wig.

The man who does not advertise because it costs money should quit paying salary for the same reason.

The man who does not advertise because he doesn't know how to write an advertisement should quit eating because he can't cook.

The man who does not advertise because somebody said it did not pay, should not believe the world is round because the ancients said it was flat.

Riveting Explosive Shells

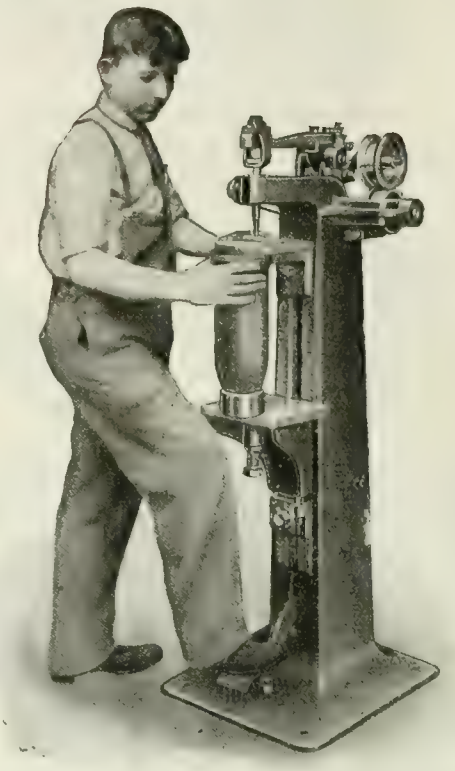


Illustration shows operator riveting the base of an explosive projectile.

This is a part of shell manufacturing which is absolutely necessary in order to prevent the gas from the explosive charge behind the shell from reaching the explosive contents of the shell itself. Neglect of this would probably cause the shell to explode in the gun and probably kill the gun crew.

After the shell is in position the machine is started and the shell is rotated one complete revolution by hand and, with the machine striking about 2,000 blows per minute, the plug can be riveted perfectly tight into the base in about ten seconds.

Change of fixture enables machine to be adapted for 4.5", 18 pounds, or shells even larger than 4.5".

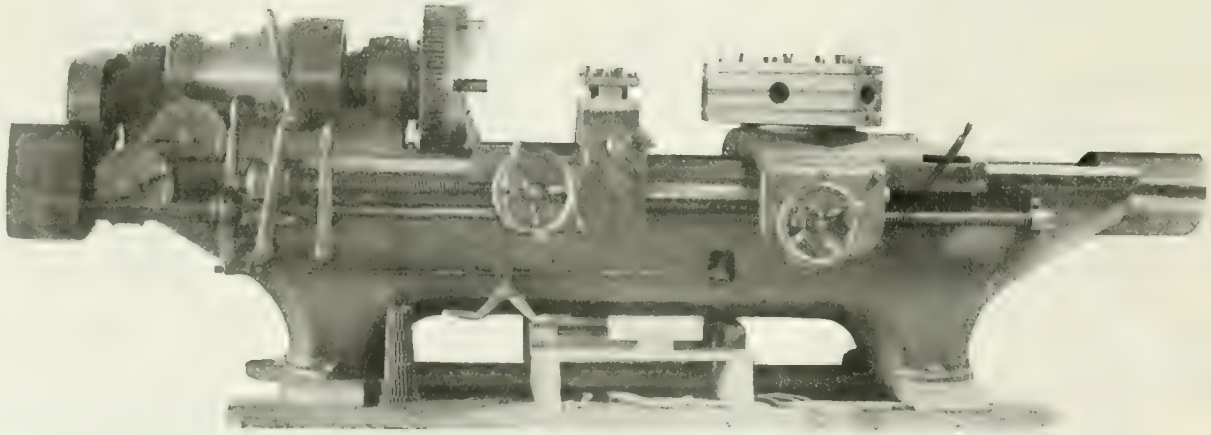
FURTHER PARTICULARS ON REQUEST.

The Grant Mfg. & Machine Company

Bridgeport, Conn., U.S.A.

PRICE $1500

A sample of our second-hand Turret Lathes. Send for full description of other tools.



SPECIFICATIONS OF SECOND-HAND TURRET LATHE.

Stock No. 53150. 28" Pond Rigid Turret Lathe with 24" four jaw independent geared chuck fitted, also taper attachment. Maker: Milwaukee Machine Tool Co., Milwaukee, Wisconsin. Swing over bed, 28". Swing over carriage ways, 26". Swing over cross slide, 24½". Bed, 24¾" wide, 12' 6" long. Cut off carriage has power cross feed, with Four-Way Tool Holders. Drive, three-step cone, 4¼" face. Friction geared head. Back gear ratio, 11 to 1. Triple gear ratio, 57 to 1. Hole in spindle, 4⅛" in diameter, counterbored to 5 1-16" diameter, distance of 12". Spindle bearings, 8" in diameter. Turret is polygon shape, has three faces size 9 x 6", and has three faces size 9 x 22", with six 3" diameter holes. Distance from face of turret to chuck, 5' 4". Length of turret travel, 5' 0". Turret rotates automatically or by hand; operates by power in either direction at rate of 12' per minute; rotates completely in 35 seconds, with independent stops for each face. Separate feed screws for the carriage, also for the turret, having six instantaneous feeds on each without changing a gear. Cross carriage will cut all threads from ½ to 64 per inch. Countershaft has tight and loose pulleys, size 18 x 4½". Weight about 11,500 lbs. Condition, excellent.

MARSHALL & HUSCHART MACHINERY CO., 17 S. Jefferson St. CHICAGO, ILL.

The advertiser would like to know where you saw his advertisement—tell him.

CANADIAN MACHINERY BUYERS' DIRECTORY

TO OUR READERS—Use this directory when seeking to buy any machinery or power equipment. You will often get information that will save you money.

TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.

TO NON-ADVERTISERS—A rate of $5 per line a year is charged non-advertisers.

Abrasive Materials.
Can. Fairbanks-Morse Co., Montreal.
Carborundum Co., Niagara Falls, N.Y.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Dom. Abrasive Wheel Co., Toronto.
Ford-Smith Machine Co., Hamilton, Ont.
Gardner Machine Co., Beloit, Wis.
Norton Co., Worcester, Mass.
Stevens, F. B., Detroit, Mich.

Acetylene.
L'Air Liquide Society, Montreal, Toronto.

Acetylene Generators.
L'Air Liquide Society, Montreal, Toronto.

Accumulators, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Wks., Chicago.
Wm. Tod Company, Youngstown, O.
Watson-Stillman Co., Aldene, N.J.
R. D. Wood Co., Philadelphia, Pa.

Air Compressors.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.

Air Hoists.
Q. M. S. Company, Chicago, Ill.
Whiting Foundry Equipment Co., Harvey, Ill.

Air Hose.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Can. Ingersoll-Rand Co., Montreal.
Independent Pneumatic Tool Co., Chicago, Ill.

Air Receivers.
Can. Ingersoll-Rand Co., Montreal.

Air Washers.
Buffalo Forge Co., Buffalo, N.Y.
Can. Sirocco Co., Ltd., Windsor, Ont.

Ammeters.
Brown Inst. Co., Philadelphia, Pa.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Aluminum.
M. & L. Samuel, Benjamin & Co., Toronto.
Tallman Brass & Metal Co., Hamilton.

Alloys, Steel.
H. A. Drury Co., Ltd., Montreal.
Vanadium Alloys Steel Co., Pittsburg, Pa.

Architectural Engineers.
Hooper-Falkenau Eng. Co., New York.

Arbors.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co., New Bedford.
Plessisville Foundry, Plessisville, Que.
Pratt & Whitney Co., Dundas, Ont.

Assembling Stands.
Skinner Chuck Co., New Britain, Conn.

Automatic Chucks.
Garvin Machine Co., New York.

Asbestos Packing.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Autogenous Welding and Cutting Plants.
L'Air Liquide Society, Montreal, Toronto.

Automatic Index Milling Machines.
Garvin Machine Co., New York.
National Machinery and Supply Co., Hamilton.

Automatic Lowering Devices.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Automatic Machinery.
Baird Machine Co., Bridgeport, Conn.
A. R. Williams Machy. Co., Toronto.
Gardner, Robt. & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
Pratt & Whitney Co., Dundas, Ont.
Owen Sound Iron Works Co., Owen Sound.
A. O. Walworth & Co., Chicago, Ill.
Windsor Machine Co., Windsor, Vt.

Automatic Multiple Spindle.
Windsor Machine Co., Windsor, Vt.

Automatic Wood Screw Machines.
Asa F. Cook Co.

Axle Cutters.
Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Hespeler, Ont.

Babbitt Metal.
Can. Fairbanks-Morse Co., Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co., Montreal.
Tallman Brass & Metal Co., Hamilton.

Baking Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.
Owen Sound Iron Works Co., Owen Sound.

Ball Bearings.
Can. Fairbanks-Morse Co., Montreal.
Chapman Double Ball Bearing Company, Toronto.

Ball Burnishing Machines.
Baird Machine Co., Bridgeport, Conn.

Banding Machines, Hydraulic.
West Tire Setter Co., Rochester, N.Y.

Barrels, Steel Shop.
Baird Machine Co., Bridgeport, Conn.
Canadian Steel Products Company, Montreal.
Cleveland Wire Spring Co., Cleveland.

Bars, Boring.
Charles F. Elmes Eng. Works, Chicago
Niles-Bement-Pond Co., New York.
Owen Sound Iron Works Co., Owen Sound.

Bar Benders and Straight Edges.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Bar Benders, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Belt Benches.
Tabor Mfg. Co., Philadelphia, Pa.

Belt Dressing and Cement.
Commercial Oil Co., Hamilton, Ont.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Graton & Knight Mfg. Co., Montreal.

Belt Lacing, Leather.
Graton & Knight Mfg. Co., Montreal.

Belting, Chain.
Can. Fairbanks-Morse Co., Montreal.
Graton & Knight Mfg. Co., Montreal.
Jones & Glassco, Montreal.

Belting, Cotton.
Dominion Belting Co., Hamilton.

Belting, Leather.
Can. Fairbanks-Morse Co., Montreal.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Girard Machine & Tool Co., Philadelphia, Pa.
Graton & Knight Mfg. Co., Montreal.
D. K. McLaren, Ltd., Montreal.

Belting, Stitched Cotton Duck.
Dominion Belting Co., Hamilton, Ont.

Belting, Rubber.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Benders, Angle and Tee Iron.
Can. Buffalo Forge Co., Montreal.
Watson-Stillman Co., Aldene, N.J.

Bending Machinery.
John Bertram & Sons Co., Dundas.
Bertrams, Limited, Edinburgh, Scotland.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Buffalo Forge Co., Montreal.
Charles F. Elmes Eng. Works, Chicago
Jardine, A. B., & Co., Hespeler, Ont.
National Machinery Co., Tiffin, Ohio.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Owen Sound Iron Works Co., Owen Sound.
Toledo Machine & Tool Co., Toledo, O.
Steel Bending Brake Works, Chatham, Ont.
Watson-Stillman Co., Aldene, N.J.

Bins, Steel.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Bit Brace Tools.
Wells Bros. Co., Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Blast Gauges, Cupola.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blocks, Lifting.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.

Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Girard Machine & Tool Co., Philadelphia, Pa.
Sheldons, Ltd., Galt, Ont.

Blow Pipes and Regulators.
L'Air Liquide Society, Montreal, Toronto.

Blue Print Machinery.
Revolute Machine Co., New York.

Bluing Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Boilers.
Can. Locomotive Co., Kingston, Ont.
National Machinery & Supply Co., Hamilton.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.
Polson Iron Works, Toronto.

Boiler Compounds.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Boiler Graphite.
Dixon Crucible Co., Jersey City, N.J.

Boiler Makers' Supplies.
Jno. F. Allen Co., New York.
Polson Iron Works, Toronto.

Bolt Cutters and Nut Tapers.
Wells Brothers Co., Greenfield, Mass.

Bolts.
Galt Machine Screw Co., Galt, Ont.
London Bolt & Hinge Works, London, Ont.

Bolt and Nut Machinery.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas, Ont.
Owen Sound Iron Works Co., Owen Sound.
Gardner, Robt., & Son, Montreal.
Landis Machine Co., Waynesboro, Pa.
National Machinery Co., Tiffin, O.
National Machinery & Supply Co., Hamilton.
Wiley & Russell Co., Greenfield, Mass.

Books
MacLean Publishing Co., Toronto.

Boring Machines, Upright and Horizontal.
John Bertram & Sons Co., Dundas.
Colburn Machine Tool Co., Franklin, Pa.
Detrick & Harvey Machine Co., Baltimore, Md.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N.Y.
A. O. Walworth & Co., Chicago, Ill.

Boring Machines, Pneumatic, Cylinder.
Baker Brothers, Toledo, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Ingersoll-Rand Co., Montreal.
Independent Pneumatic Tool Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Stow Mfg. Co., Binghamton, N.Y.
A. O. Walworth & Co., Chicago, Ill.

Boring Machines (Railroading).
Newton Machine Tool Works, Philadelphia, Pa.

Boring and Turning Mills.
John Bertram & Sons Co., Dundas.
Colburn Machine Tool Co., Franklin, Pa.
Detrick & Harvey Machine Co., Baltimore, Md.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
A. O. Walworth & Co., Chicago, Ill.

Box Puller.
Jardine, A. B., & Co., Hespeler, Ont.

Boxes, Steel Shop.
Cleveland Wire Spring Co., Cleveland.

Boxes, Tote.
Cleveland Wire Spring Co., Cleveland.

Brakes.
Brown, Boggs & Co., Hamilton, Can.
Whiting Foundry Equipment Co., Harvey, Ill.

Brakes, Heavy Plate Bending and Cornice.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Brass Working Machinery.
A. R. Williams Machy. Co., Toronto.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Warner & Swasey Co., Cleveland.
Niles-Bement-Pond Co., New York.

Brick Cars.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Brick Dryers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.

Brick Machinery.
Eastern Machinery Co., New Haven.
Sheldons, Ltd., Galt, Ont.

Bridges, Railway and Highway.
Can. Bridge Co., Walkerville, Ont.

Bucket Elevators.
Pangborn Corporation, Hagerstown, Md.

Buckets, Clam Shell, Crab and Dump.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Buffing and Polishing Machinery.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Girard Machine & Tool Co., Philadelphia, Pa.
Gray Mfg. & Machine Co., Toronto.
New Britain Machine Co. New Britain, Conn.

Bulldozers.
John Bertram & Sons Co., Dundas.
Canada Mach. Corporation, Galt, Ont.
E. W. Bliss Co., Brooklyn, N.Y.
National Machinery & Supply Co., Hamilton, Ont.
Watson-Stillman Co., Aldene, N.J.

Burners, Enclosed Flame Gas.
Oven Equipment & Mfg. Co., New Haven, Conn.

Burners, Fuel, Oil and Natural Gas.
Whiting Foundry Equipment Co., Harvey, Ill.

Burring Reamers.
Wells Brothers Company, Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Butterises.
Wells Brothers Company, Greenfield, Mass.

Burrs, Iron and Copper.
Parmenter & Bulloch Co., Gananoque.

Canners' Machinery.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
National Machinery & Supply Co., Hamilton, Ont.

Cars, Industrial.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Castings, Aluminum.
Cunningham & Son, St. Catharines, Ont.
Owen Sound Iron Works Co., Ltd., Owen Sound, Ont.
St. Lawrence Foundry, Galt, Ont.
Tallman Brass & Metal Co., Hamilton

Castings, Air Furnaces.
Wm. Tod Company, Youngstown, O.

Castings, Brass.
Cunningham & Son, St. Catharines, Ont.
Alexander Fleck, Ltd., Ottawa.
T. C. Lawrence Foundry, Galt, Ont.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.
Tallman Brass & Metal Co., Hamilton
Wm. Tod Company, Youngstown, O

Castings, Bronze.
Cunningham & Son, St. Catharines, Ont.
Tallman Brass & Metal Co., Hamilton
Wm. Tod Company, Youngstown, O.

Castings, Copper.
Cunningham & Son, St. Catharines, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Castings, Gray Iron.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Castings of Ottawa, Ottawa, Ont.
Erie Foundry Co., Erie, Pa.
Alexander Fleck, Ltd., Ottawa.
Gardner, Robt., & Son, Montreal.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.
Wm. Tod Company, Youngstown, O.

Castings, Steel Chrome and Manganese Steel.
Electric Steel & Metals Co., Welland.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Wm. Tod Company, Youngstown, O.

Castings, Malleable.
Galt Malleable Iron Co., Galt.

Castings, Nickel Steel.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.

Cement, Disc Wheel.
Gardner Machine Co., Beloit, Wis.

Cement, Iron.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Shelton Metallic Filler Co., Derby, O.

Cement Machinery.
Can. Fairbanks-Morse Co., Montreal.
Gardner, Robt., & Son, Montreal.
National Machinery & Supply Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound.

Centre Reamers.
Wells Brothers Co., Greenfield, Mass.

Centering Machines.
John Bertram & Sons Co., Dundas.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.

Centrifugal Pumps.
Can. Buffalo Forge Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.
Smart-Turner Machine Co., Hamilton, Ont.

Chain Blocks.
Can. Fairbanks-Morse Co., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
National Machinery & Supply Co., Hamilton.

Chain Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Clutches.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chains, Silent and Transmission.
Jones & Glassco, Montreal.
John Millen & Son, Montreal.
Morse Chain Co., Ithaca, N.Y.
Plessisville Foundry, Plessisville, Que.

Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chucks, Acro, Automatic.
Garvin Machine Co., New York.

Chucks, Drill, Lathe and Universal.
John Bertram & Sons Co., Dundas, Ont.
Buffalo Forge Co., Buffalo, N.Y.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Cushman Chuck Co., Hartford, Conn.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Wells Brothers Co., Greenfield, Mass.
Jacobs Mfg. Co., Hartford, Conn.
Ker & Goodwin, Brantford.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford.
National Machinery & Supply Co., Hamilton.
Skinner Chuck Co., New Britain, Conn.
D. E. Whiton Machine Co., New London, Conn.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Chucks, Drill, Automatic and Keyless.
Buffalo Forge Co., Buffalo, N.Y.

Chucks, Ring Wheel.
Gardner Machine Co., Beloit, Wis.

Chucking Machines.
W. P. Davis Machine Co., Rochester, N.Y.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
New Britain Machine Co., New Britain, Conn.
Niles-Bement-Pond Co., New York.
Turner Machine Co., Danbury, Conn.
Warner & Swasey Co., Cleveland, O.

Cinder Mills.
W. W. Sly Mfg. Co., Cleveland, O.

Cleaning Mills.
W. W. Sly Mfg. Co., Cleveland, O.

Cloth and Wool Dryers.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Sheldons, Limited, Galt.

Clutches.
Eastern Machinery Co., New Haven, Conn.
Jones & Glassco, Montreal.
Owen Sound Iron Works Co., Owen Sound.
Positive Clutch & Pulley Works, Ltd., Toronto.

Coal Handling Machinery.
Whiting Foundry Equipment Co., Harvey, Ill.

Coke and Coal.
Hanna & Co., M. A., Cleveland, O.

Collectors. Pneumatic.
Can. Buffalo Forge Co., Montreal.
Sheldons, Limited, Galt.

Compressors, Air.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.
National Machinery & Supply Co., Hamilton.
The Smart-Turner Machine Co., Hamilton.

Concentrating Plant.
Gardner, Robt., & Son, Montreal.

Concrete Mixers.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
National Machinery & Supply Co., Hamilton.

Concrete Reinforcement.
Canada Wire Goods Mfg. Co., Hamilton.

Condensers.
Can. Buffalo Forge Co., Montreal.
The Smart-Turner Machine Co., Hamilton.
Wm. Tod Company, Youngstown, O.

Consulting Engineers.
Hooper-Falkenau Eng. Co., New York.

Controllers and Starters, Electric Motor.
A. R. Williams Machy. Co., Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Conveyors, Belt and Screw.
Panghorn Corporation, Hagerstown, Ind.

Conveyor Machinery.
Can. Fairbanks-Morse Co., Montreal.
Can. Mathews Gravity Carrier Co., Toronto.
National Machinery & Supply Co., Hamilton, Ont.
Plessisville Foundry, Plessisville, Que.
The Smart-Turner Machine Co., Hamilton.

Coping Machines.
Can. Buffalo Forge Co., Montreal.
John Bertram & Sons Co., Dundas.
National Machinery & Supply Co., Hamilton, Ont.
Niles-Bement-Pond Co., New York.

Cornice Brakes.
Brown Boggs Co., Ltd., Hamilton, Canada.
Steel Bending Brake Wks., Chatham.

Counters.
C. J. Root Co., Bristol, Conn.

Counterbores and Countersinks.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Countershafts.
Baird Machine Co., Bridgeport, Conn.
Standard Pressed Steel Co., Philadelphia, Pa.
Wells Bros. Co., Greenfield, Mass.

Country House Lighting and Cooking.
Can. Blaugas Co., Montreal.

Couplings.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Eastern Machinery Co., New Haven, Conn.
Gardner, Robt., & Son, Montreal.
Owen Sound Iron Works Co., Owen Sound, Ont.

Couplings, Air Hose.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Crabs, Travelling.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Owen Sound Iron Works Co., Owen Sound.

Cranes, Locomotive.
Northern Crane Works, Walkerville.

Cranes, Gantry.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Goliath.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Cranes, Pneumatic.
Northern Crane Works, Walkerville.
Q. M. S. Co., Chicago, Ill.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Post Jib.
Northern Crane Works, Walkerville.
Q. M. S. Co., Chicago, Ill.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Portable.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Swing Jib.
Northern Crane Works, Walkerville.
Q. M. S. Co., Chicago, Ill.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Transfer.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Wall.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Travelling Electric and Hand Power.
Dominion Bridge Co., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Niles Bement-Pond Co., New York.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Crane, Chain.
Northern Crane Works, Walkerville.

Cranes, All Kinds.
Northern Crane Works, Walkerville.
Owen Sound Iron Works Co., Owen Sound, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine.
Niles-Bement-Pond Co., New York.

Crimps, Leather.
Graton & Knight Mfg. Co., Montreal.

Cupolas.
Can. Buffalo Forge Co., Montreal.
Northern Crane Works, Walkerville.
Sheldons, Ltd., Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola and Blast Gate Blowers.
Can. Sirocco Co., Ltd., Windsor, Ont.

Cupola Blast Gauges & Blowers.
Sheldons, Ltd., Galt, Ont.

Cutters, Angle, Tee Iron and Bar.
Can. Buffalo Forge Co., Montreal.

Cutters, Flue.
Independent Pneumatic Tool Co., Chicago.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Cutters, Pipe.
Can. Fairbanks-Morse Co., Montreal.
A. B. Jardine & Co., Hespeler, Ont.
Trimont Mfg. Co., Roxbury, Mass.

Cutting Compound & Cutting Oil.
Can. Economic Lubricant Co., Montreal.
Commercial Oil Co., Hamilton, Ont
Crescent Oil Co., New York.

Cutter Grinders and Attachments
Cincinnati Milling Machine Co., Cincinnati.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.

Cutters, Milling.
A. R. Williams Machy. Co., Toronto
Can. Fairbanks-Morse Co., Montreal
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit, Mich.
Garvin Machine Co., New York.
Morse Twist Drill and Machine Co., New Bedford.
Tabor Mfg. Co., Philadelphia, Pa.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Cutting-off Machines.
Armstrong Bros. Tool Co., Chicago.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
W. P. Davis Machine Co., Rochester, N.Y.
Earle Gear & Machine Co., Philadelphia, Pa.
Espen-Lucas Machine Wks., Philadelphia, Pa.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Geo. Gorton Machine Co., Racine, Wis.
Newton Machine Tool Works, Philadelphia, Pa.
Nutter & Barnes Co., Hinsdale, N.H.
Pratt & Whitney Co., Dundas, Ont.
Q. M. S. Co., Chicago, Ill.
Tabor Mfg. Co., Philadelphia, Pa.
L. S. Starrett Co., Athol, Mass.

Damper Regulators.
Can. Fairbanks-Morse Co., Montreal.

Derricks.
Dominion Bridge Co., Montreal.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Designers, Special Machinery.
Baird Machine Co., Bridgeport, Conn.
Hooper-Falkenau Eng. Co., New York.

Dies and Die Stocks.
Armstrong Mfg. Co., Bridgeport, Conn.
Banfield, W. H. & Son, Toronto.
Butterfield & Co., Rock Island, Que.
Brown, Boggs & Co., Hamilton, Ont.
Can. Fairbanks-Morse Co., Montreal.
Duncan Electrical Co., Montreal.
Gardner, Robt., & Son, Montreal.
Greenfield Tap & Die Corporation, Greenfield, Mass.
A. B. Jardine & Co., Hespeler, Ont.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wiley & Russell, Greenfield, Mass.

Dies for Bit Brace Use.
Wells Brothers Co., Greenfield, Mass.

Die Castings.
Tallman Brass & Metal Co., Hamilton

Die Sinkers.
Garvin Machine Co., New York.

Dies for Machines.
Wells Brothers Co., Greenfield, Mass.

Die Sinking Presses, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Watson Stillman Co., Aldene, N.J.

Dies, Self-opening.
Duncan Electrical Co., Montreal.
Geometric Tool Co., New Haven.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit

Once Known— Always Used

M. E. C. Collapsible Taps

are giving extraordinary service on Shrapnel and Cartridge SHELL work.

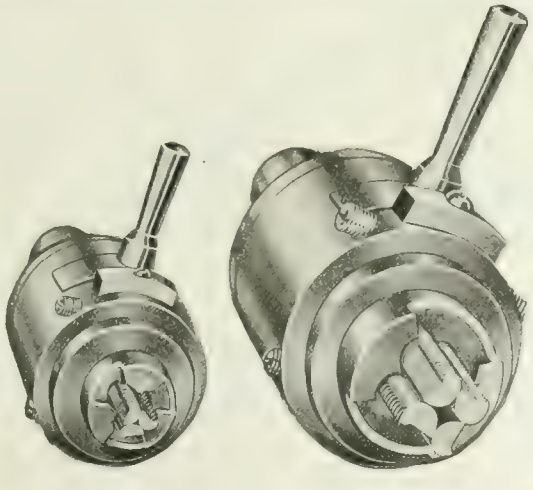
It will be Greatly to your interest to get a line on the value of this tap. WRITE SOME USERS — we'll gladly send names and addresses.

Full particulars and details of our liberal proposition on request.

Manufacturers Equipment Co.

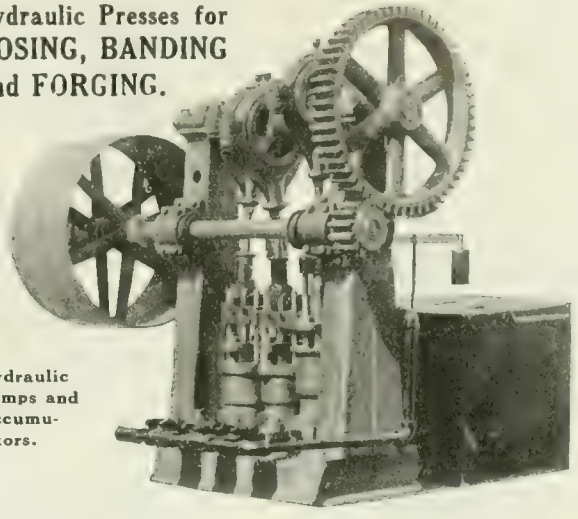
175 North Jefferson St., CHICAGO, U.S.A.

Canadian Agents:
FOSS & HILL MACHINERY CO., Montreal.
A. R. WILLIAMS MACHINERY CO., Winnipeg.



Presses for Shrapnel

Hydraulic Presses for NOSING, BANDING and FORGING.



Hydraulic Pumps and Accumulators.

Hydraulic Presses for all purposes.

KNOWING MEANS USING

Write for full details now.

William R. Perrin, Limited

TORONTO, ONTARIO

A Valuable New Book on an Important Trade

PATTERN-MAKING

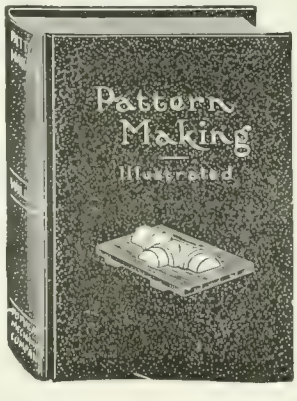
By G. H. WILLARD

Two Significant Opinions:

"I think the book is the best I ever saw for the price." Edwin Sluyter, Construction Engineer, Burroughs Adding Machine Co., Detroit.

"I consider this is a valuable book and should be in the hands of all men engaged in this line of business." E. W. Clarke, Wilmington Malleable Iron Co., Wilmington, Delaware.

224 Pages. 312 Illustrations. Cloth Cover.



With Additional Chapters on Core-Making and Molding

"WRITTEN SO YOU CAN UNDERSTAND IT."

A book for the man who does the work. Written by a practical patternmaker of many years' experience. Gets right down to business in the first chapter and keeps it up throughout the book. Full of kinks and actual working information. Profusely illustrated.

Chapter Headings

I. Pattern-Making as a Trade. II. The Tools. III. Woods. IV. Joints. V. Turning. VI. Turning (Continued). VII. Turning (Continued). VIII. Turning (Concluded). IX. The Circular Saw. X. The Circular Saw (Continued). XI. Machine Tools. XII. Machine Tools (Continued). XIII. Simple Patterns. XIV. Simple Patterns (Continued). XV. Simple Patterns (Concluded). XVI. Crooked Patterns. XVII. Large Pattern Work. XVIII. Large Pattern Work (Continued). XIX. Crosshead Guide Patterns. XX. Sweep Work. XXI. Pipe Work. XXII. Stove Pattern Work. XXIII. Molding—Machine Work. XXIV. Molding—Pattern Work.

Part II.—Core-Making and Molding.

Chapter I. Core-Making, Simple and Complex. II. Principles in Molding. III. Loam Patterns and Loam Molds. Everyone following this trade, or intending to learn it, should have a copy of this valuable book.

Price $1.10 Postpaid.

Technical Book Department
The MacLean Publishing Company, Limited
143-153 University Ave., Toron t

Dies, Opening.
W. H. Banfield & Sons, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Duncan Electrical Co., Montreal.
Greenfield Tap & Die Corporation, Greenfield, Mass.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.
Pratt & Whitney Co., Dundas, Ont.

Dies for Screw Plates.
Wells Brothers Co., Greenfield, Mass.

Dies, Sheet Metal Working.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.

Dies, Screws and Thread.
Armstrong Mfg. Co., Bridgeport, Conn.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.

Discs, Leather.
Graton & Knight Mfg. Co., Montreal.

Draughtsman's Tools.
Emmert Mfg. Co., Waynesboro, Pa.

Draft, Mechanical.
W. H. Banfield & Sons, Toronto.
Butterfield & Co., Rock Island, Que.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
A. B. Jardine & Co., Hespeler, Ont.
Pratt & Whitney Co., Dundas, Ont.
Sheldons, Limited, Galt, Ont.

Drift Bolt Cutters.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Drill Presses.
Baker Bros., Toledo, O.
W. F. & John Barnes Co., Rockford.
Can. Buffalo Forge Co., Montreal.
W. P. Davis Machine Co., Rochester, N.Y.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
A. R. Williams Machinery Co., Toronto.

Drilling Machines, Locomotive and Multiple Spindle.
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Colburn Mach. Tool Co., Franklin, Pa.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler, Ont.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial and Turret.
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Motch & Merryweather Machy. Co., Cleveland, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Bement Pond Co., New York.
Turner Machine Co., Danbury, Conn.

Drilling Machines, Sensitive.
Baker Bros., Toledo, O.
W. F. & John Barnes Co., Rockford.
Can. Fairbanks-Morse Co., Montreal.
Niles Bement Pond Co., New York.
Rockford Machine Tool Co., Rockford.

Drilling Machines, Upright and Horizontal.
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
Colburn Mach. Tool Co., Franklin, Pa.
W. P. Davis Machine Co., Rochester, N.Y.
Detrick & Harvey Machine Co., Baltimore, Md.
A. R. Williams Machy. Co., Toronto
W. F. & John Barnes Co., Rockford.
John Bertram & Sons Co., Dundas.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler, Ont.
Rockford Machine Tool Co., Rockford.
R. McDougall Co., Galt.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drilling Posts.
Keystone Mfg. Co., Buffalo, N.Y.

Drills, Bench.
W. F. & John Barnes Co., Rockford.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks Morse Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.
United States Electrical Tool Co. Cincinnati.

Drills, Blacksmith and Bit Stock.
Can. Buffalo Forge Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills, Centre.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill and Machine Co. New Bedford.
Pratt & Whitney Co., Dundas, Ont.
L. S. Starrett Co., Athol, Mass.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills Corner (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.

Drills, Electric and Portable.
A. R. Williams Machy. Co., Toronto.
Can. Buffalo Forge Co., Montreal.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N.Y.
United States Electrical Tool Co., Cincinnati, O.

Drills, High Speed.
Baker Bros., Toledo, O.
Cleveland Twist Drill Co., Cleveland.
Can. Fairbanks-Morse Co., Montreal.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill and Machine Co., New Bedford.
W. F. & John Barnes Co., Rockford, Ill.
Pratt & Whitney Co., Dundas, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills, Multiple Spindle.
Pratt & Whitney Co., Dundas, Ont.
Niles-Bement-Pond Co., New York.

Drills, Oil Tube.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co. New Bedford.
Wiley & Russell, Greenfield, Mass.

Drills, Pneumatic.
John F. Allen Co., New York.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.

Drills, Ratchet and Hand.
Armstrong Bros. Tool Co., Chicago.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit, Mich.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.

Drills, Rock.
A. R. Williams Machy. Co., Toronto.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Drills, Track.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drills, Twist.
Armstrong, Whitworth of Canada, Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
John Morrow Screw Co., Ingersoll, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drill Holders.
Wells Brothers Co., Greenfield, Mass.

Drill Sockets.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drying Appliances.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.

Drying Out Barrels.
Baird Machine Co., Bridgeport, Conn.

Drying Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Dump Cars.
Can. Fairbanks-Morse Co., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
National Machinery & Supply Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.

Dust Separators.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Dust Arresters (for Tumbling Mills).
W. W. Sly Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos and Electrical Supplies.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Lancashire Dynamo and Motor Co., Ltd., Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Electrical Instruments.
Brown Inst. Co., Philadelphia, Pa.

Electrical Supplies.
Duncan Electrical Co., Montreal.

Elevator Enclosures.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works, London, Ont.

Elevating and Conveying Machinery.
Barkey Bros., Stouffville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Plessisville Foundry, Plessisville, Que.

Emery Grinders (Pneumatic).
Barkey Bros., Stouffville, Ont.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Stow Mfg. Co., Binghamton, N.Y.

Emery and Emery Wheels.
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Hamilton, Ont.
Dom. Abrasive Wheel Co., Toronto.
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Emery Wheels, Dressers and Stands.
Canadian Hart Wheels, Hamilton, Ont.
Dom. Abrasive Wheel Co., Toronto.
Gardner, Robt., & Son, Montreal.
National Machinery & Supply Co. Hamilton, Ont.
Norton Co., Worcester, Mass.

Emery Wheel Safety Flanges.
Canadian Hart Wheels, Hamilton, Ont.

Enameling Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Engines, Corliss, Compound, Pumping.
Wm. Tod Company, Youngstown, O.

Engines, Gas and Gasoline.
Can. Fairbanks-Morse Co., Montreal.
Jones & Glassco, Montreal.
National Machinery & Supply Co., Hamilton.
Wm. Tod Company, Youngstown, O.

Engines, Horizontal and Vertical.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
A. R. Williams Machy. Co., Toronto.
Sheldons, Ltd., Galt, Ont.
Wm. Tod Co., Youngstown, O.

Engines, High-Speed, Automatic.
Can. Buffalo Forge Co., Montreal.

Engines, Steam.
Can. Buffalo Forge Co., Montreal.
John Inglis Co., Toronto.
Plessisville Foundry, Plessisville, Que.
Wm. Tod Company, Youngstown, O.

Engineers, Industrial.
Hooper-Falkenau Eng. Co., New York.

Engineering Books.
The MacLean Publishing Co., Ltd., Toronto.

Engraving Machines.
Geo. Gorton Machine Co., Racine, Wis.

Elevators and Buckets.
Eastern Machinery Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Equipment Shop.
Baird Machine Co., Bridgeport, Conn.
Garvin Machine Co., New York.
Wm. Tod Co., Youngstown, O.

Escutcheon Pins.
Parmenter & Bulloch Co., Gananoque.

Evaporators' Machinery.
Brown, Boggs & Co., Hamilton, Can.

Exhaust Heads and Hoods.
Can. Buffalo Forge Co., Montreal.
Can. Steel Products Co., Montreal.
Can. Fairbanks Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Exhausters.
Can. Buffalo Forge Co. Montreal
Can. Sirocco Co., Ltd., Windsor, Ont.

Experimental Machinery.
Owen Sound Iron Works Co., Owen Sound.

Fans.
Can. Buffalo Forge Co., Berlin, Ont.
Baird Machine Co., Bridgeport, Conn.
Can. Sirocco Co., Ltd., Windsor, Ont.
Plessisville Foundry, Plessisville, Que.
Sheldons, Ltd., Galt, Ont.
The Smart-Turner Machine Co., Hamilton.

Feed Water Heaters.
Can. Fairbanks-Morse Co., Montreal.
The Smart-Turner Machine Co., Hamilton.

Fence, Iron Factory.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Files.
American Swiss File & Tool Co., New York.
Delta File Works, Philadelphia, Pa.
Nicholson File Co., Port Hope, Ont.

Fire Extinguishers.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Fire Escapes.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works, London, Ont.

Flexible Shafts.
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N.Y.

Forges, Hand, etc.
Can. Buffalo Forge Co., Montreal.
Independent Pneumatic Tool Co., Chicago, Ill.
National Machinery & Supply Co., Hamilton.
Sheldons, Limited, Galt, Ont.

Forgings, Drop, Automobile and Locomotive.
Bliss, E. W., Co., Brooklyn, N.Y.
Canadian Billings & Spencer, Ltd., Welland.
J. H. Williams Co., Brooklyn, N.Y.

Forging Hammers, Belt-Driven.
Bliss, E. W., Co., Brooklyn, N.Y.
Plessisville Foundry, Plessisville, Que.

Forging Hammers, Steam.
Erie Foundry Co., Erie, Pa.

Forging Ingots.
Electric Steel & Metals Co., Welland.

Forging Machinery.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
National Machinery Co., Tiffin, Ohio.
Plessisville Foundry, Plessisville, Que.
Wm. Tod Company, Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Foundry Engineers.
Hooper-Falkenau Eng. Co., New York.

Foundry Equipment.
Northern Crane Works, Walkerville.
W. W. Sly Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.

Friction Leathers.
Graton & Knight Mfg. Co., Montreal.

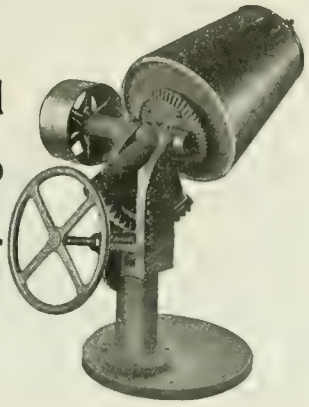
Friction Clutch Pulleys, etc.
Baird Machine Co., Bridgeport, Conn.
Eastern Machinery Co., New Haven, Conn.
Owen Sound Iron Works Co., Owen Sound.

Furnace Engineers and Contractors.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Oil, Coal, Gas and Electric.
Canadian Hoskins, Limited, Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
W. S. Rockwell Co., New York.
Strong, Carlisle & Hammond, Cleveland, O.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Steel Heating and Brass Melting.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
W. S. Rockwell Co., New York.
Strong, Carlisle & Hammond, Cleveland, O.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Make One Barrel Do What Two Barrels Did Before



THE minute you install one Globe Tumbling Barrel you can pension two of your old-fashioned horizontal barrels and still do a wider variety of work —and do it a great deal better and many times faster.

GLOBE TUMBLING BARRELS

save time because they don't have to be stopped for filling, emptying or inspecting of the work. They save floor space, because they stand vertically and occupy little room—and they save money, because they require a smaller investment in barrels.

Eight stock sizes, $50 to $170. Our Booklet 2 contains useful information on tumbling — shows the different styles of Globe Barrels and tells what each will do. Write for a free copy to-day.

The Globe Machine & Stamping Co.
Cleveland, Ohio, U. S. A.

This COUPON → will bring you our NEW BOOKLET which will demonstrate to you the unlimited Ways of Using an

L'AIR LIQUIDE SOCIETY
Maisonneuve—Montreal, P. Q.

Send, without obligating me, postpaid, your NEW BOOKLET, which I promise to read.

NAME .....
ADDRESS .....
Province .....Date .....
Business .....C.M

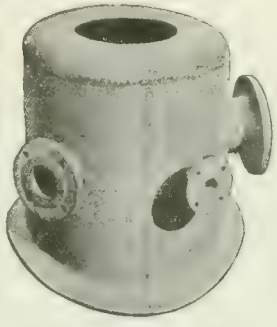
OXY-ACETYLENE WELDING and CUTTING PLANT

Our LATEST Portable Dissolved Acetylene Plant.

TWO CYLINDERS ONLY
(1 Oxygen, 1 Acetylene)

Handy, Clean, Ever-Ready, Pure Gas, Safe, Low-Priced.

MADE-IN-CANADA GOODS



Welded Collector, with Flanges also Welded on.

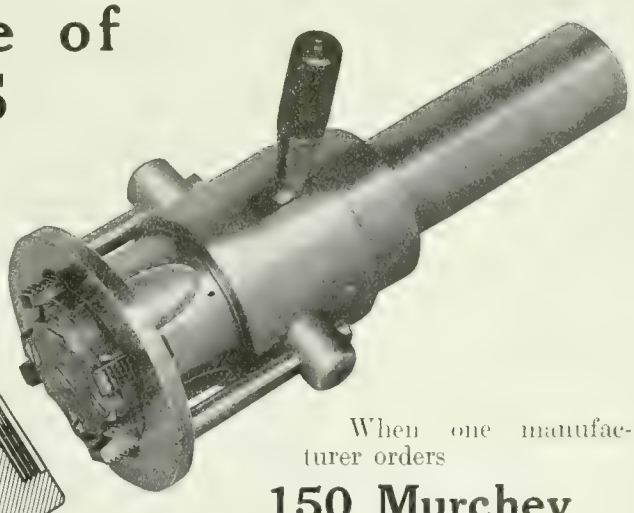
L'AIR LIQUIDE SOCIETY
(Paid-up Capital $2,200,000.00)

26 Boler St. WEST TORONTO — Maisonneuve— MONTREAL — 325 William Ave. WINNIPEG

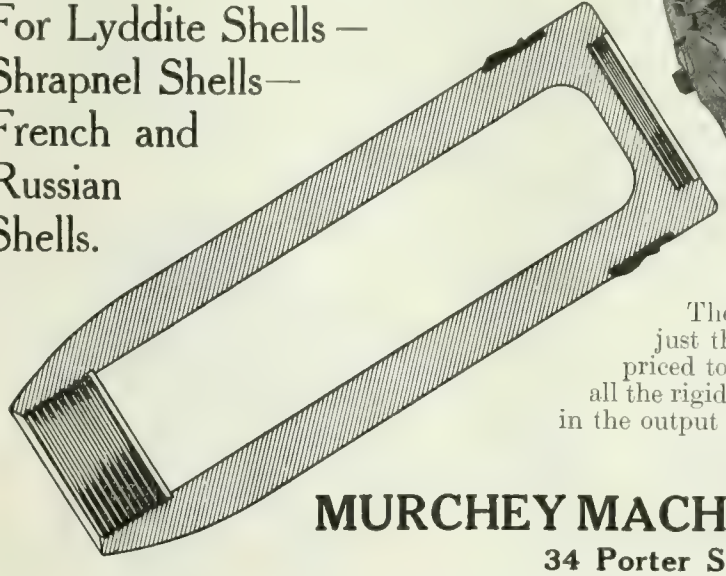
EVERYTHING in the OXY-ACETYLENE LINE,
the ONLY GAS COMBINATION, worth while consideration for successful Welding and Cutting.

Threading the Base of LYDDITE SHELLS

Here is the Tool—Murchey Collapsing Tap with overhanging chasers—doing the work and doing it well.



For Lyddite Shells — Shrapnel Shells— French and Russian Shells.



When one manufacturer orders

150 Murchey Collapsing Taps

There must be a reason. There is a reason. It's just this—these taps are taking the place of higher-priced tools, and they are speeding up production with all the rigid accuracy and quality of work that is demanded in the output of shell work.

Write for details and catalog.

MURCHEY MACHINE & TOOL COMPANY
34 Porter St., Detroit, Michigan

If what you want is not advertised in th where you saw his advertisement—tell him.

Furnaces, Heat Treating, Hardening and Tempering.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
W. S. Rockwell Co., New York.
Strong, Carlisle & Hammond, Cleveland, O.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Forging.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Annealing, etc.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
W. S. Rockwell Co., New York.
Strong, Carlisle & Hammond, Cleveland, O.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces for Baking, Bluing, Drying, Enameling, Japanning and Lacquering.
Oven Equipment & Mfg. Co., New Haven, Conn.

Furnace Lining.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Fuse Cap Machinery.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Gang Planer Tools.
Armstrong Bros. Tool Co., Chicago.

Gaskets, Leather, etc.
Graton & Knight Mfg. Co., Montreal.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Gas Blowers and Exhausters.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Limited, Galt.

Gas Burners.
Oven Equipment & Mfg. Co., New Haven, Conn.

Gas Machines.
Brown, Boggs & Co., Hamilton, Can.

Gas Producer Plants.
Can. Fairbanks-Morse Co., Montreal.

Gauges, Hydraulic Pressure.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Gauges, Standard.
Brown Inst. Co., Philadelphia, Pa.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Holden-Morgan Co., Toronto.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Hartford, Conn.
Garvin Machine Co., New York.
National Machinery & Supply Co., Hamilton.

Gear-Cutting Machinery.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
A. R. Williams Machy. Co., Toronto.
Sheldons, Limited, Galt, Ont.
The Smart-Turner Machine Co., Hamilton.
Wm. Tod Co., Youngstown, O.
D. E. Whiton Machine Co., New London, Conn.

Gears, Cut, Mortise, Angle, Worm.
Earle Gear & Machine Co., Philadelphia, Pa.
Gardiner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Jones & Glassco, Montreal, P.Q.
Philadelphia Gear Works, Philadelphia, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Wm. Tod Co., Youngstown, O.

Gears, Rawhide.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Gardiner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal, P.Q.
Philadelphia Gear Works, Philadelphia, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

Generators, Electric.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton.
Lancashire Dynamo and Motor Co., Ltd., Toronto.
Toronto and Hamilton Electric Co., Hamilton.

Grain for Polishing.
Norton Co., Worcester, Mass.

Grates, Shaking and Dumping.
Erie Foundry Co., Erie, Pa.

Graphite.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Gravity Lowering Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Grease Lubriko.
Commercial Oil Co., Hamilton, Ont.

Grinders, Automatic Knife.
W. H. Banfield & Son, Toronto.

Grinders, Centre, Pedestal and Bench.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Ford-Smith Machine Co., Hamilton.
Gray Mfg. & Machine Co., Toronto.
Niles-Bement-Pond Co., New York.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
New Britain Machine Co., New Britain, Conn.
Norton Grinding Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N.Y.
United States Electrical Tool Co., Cincinnati, O.

Grinders, Cutter.
Brown & Sharpe Mfg. Co., Providence, R.I.
Greenfield Machine Co., Greenfield, Mass.
Pratt & Whitney Co., Dundas, Ont.

Grinders, Die Chaser.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.

Grinders, Disk.
Armstrong Bros. Tool Co., Chicago, Ill.
Gardner Machine Co., Beloit, Wis.
Norton Grinding Co., Worcester, Mass.

Grinders, Drill.
Garvin Machine Co., New York.
United States Electric Tool Co., Cincinnati, O.

Grinders, Cylinder, Internal.
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Fitchburg Grinder Co., Fitchburg, Mass.
Girard Machine & Tool Co., Philadelphia, Pa.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe & Grinder Co., Boston, Mass.

Grinders, Pneumatic.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Portable, Electric, Hand, Tool, Post, Floor and Bench.
Baird Machine Co., Bridgeport, Conn.
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Fitchburg Grinder Co., Fitchburg, Mass.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Hisey-Wolf Machine Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Norton Co., Worcester, Mass.
United States Electrical Tool Co., Cincinnati.
A. R. Williams Machy. Co., Toronto.

Grinders, Swing, Portable, Electric.
Hisey-Wolf Machine Co., Cincinnati, O.
United States Electrical Tool Co., Cincinnati.

Grinders, Tool and Holders.
Armstrong Bros. Tool Co., Chicago.
W. F. & John Barnes Co., Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount, J. G., & Co., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Fitchburg Grinder Co., Fitchburg, Mass.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
Rivett Lathe & Grinder Co., Boston, Mass.
Tabor Mfg. Co., Philadelphia, Pa.

Grinders, Universal, Plain.
Girard Machine & Tool Co., Philadelphia, Pa.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.

Grinders, Vertical Surface.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Pratt & Whitney Co., Dundas, Ont.

Grinding and Polishing Machines, Portable, Pneumatic and Spring Frame.
Bath Grinder Co., Fitchburg, Mass
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Fitchburg Grinder Co., Fitchburg, Mass.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Gray Mfg. & Machine Co., Toronto.
Greenfield Machine Co., Greenfield, Mass.
Hall & Sons, John H., Brantford.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N.Y.

Grinding Machines (Railroading).
Newton Machine Tool Works, Philadelphia, Pa.

Grinding Wheels.
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Carborundum Co., Niagara Falls.
Dom. Abrasive Wheel Co., Toronto.
Ford-Smith Machine Co., Hamilton, Canada.
Gray Mfg. & Machine Co., Toronto.
Norton Co., Worcester, Mass.

Guards, Window and Machine.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Hack Saw Blades.
Victor Saw Works, Ltd., Hamilton, Canada.
Diamond Saw & Stamping Works, Buffalo, N.Y.
L. S. Starrett Co., Athol, Mass.

Hack Saw Frames.
Ford-Smith Machine Co., Hamilton, Canada.
Garvin Machine Co., New York City.
Mussens, Limited, Montreal.

Hammer High Speed.
High Speed Hammer Co., Rochester, N.Y.

Hammers, Drop and Belt Driven.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Canadian Billings & Spencer, Ltd., Welland.
A. B. Jardine & Co., Hespeler, Ont.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Plessisville Foundry, Plessisville, Que
Toledo Machine & Tool Co., Toledo.

Hammers, Helve Power.
West Tire Setter Co., Rochester, N.Y.

Hammers, Pneumatic.
Independent Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., of Canada, Toronto.

Hammers (Rawhide).
Chicago Rawhide Mfg. Co., Chicago, Ill.

Hammers, Steam.
John Bertram & Sons Co., Dundas.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.

Hand Hoists & Trolleys.
Whiting Foundry Equipment Co., Harvey, Ill.

Hand Leathers or Pads.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Graton & Knight Mfg. Co., Montreal.

Hangers.
Baird Machine Co., Bridgeport, Conn.
Gardner, Robt., & Son, Montreal.
The Smart-Turner Machine Co., Hamilton.
Standard Pressed Steel Co., Philadelphia, Pa.

Hardness Testing Instruments.
Shore Instrument & Mfg. Co., New York.

Heating and Ventilating Engineers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Hooper-Falkenau Eng. Co., New York.
Sheldons, Ltd., Galt, Ont.

Heat Gauges, Hardening and Annealing.
Shore Instrument & Mfg. Co., New York.

Hinge Machinery.
Baird Machine Co., Bridgeport, Conn.

Hinges.
London Bolt & Hinge Works, London, Ont.

Hoists, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Hoisting and Conveying Machinery.
Northern Crane Works, Walkerville.
Owen Sound Iron Works Co., Owen Sound.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Chain, Electric and Pneumatic.
Northern Crane Works, Walkerville.
Vulcan Engineering Sales Co., Chicago, Ill.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose Clamp Tool.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Hose, Pneumatic.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Hose, Steam, Suction and Water.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Holders for Dies and Drills.
Wells Brothers, Company, Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Hydraulic Accumulators.
Can. Boomer & Boschert Press Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.
The Smart-Turner Machine Co., Hamilton.
Watson-Stillman Co., Aldene, N.J.

Hydraulic Machinery.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago.
Niles-Bement-Pond Co., New York.
John Inglis Co., Toronto.
National Machinery & Supply Co., Hamilton.
Watson-Stillman Co., Aldene, N.J.
R. D. Wood Co., Philadelphia, Pa.

Indicators, Speed.
Brown Inst. Co., Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R.I.
L. S. Starrett Co., Athol, Mass.

Index Centres.
Garvin Machine Co., New York.

Industrial Engineers.
Hooper-Falkenau Eng. Co., New York.

Ingot Metals.
M. & L. Samuel, Benjamin & Co., Toronto.

Iron Filler.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Iron Ore.
Hanna & Co., M. A., Cleveland, O.

Jacks, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N. J.

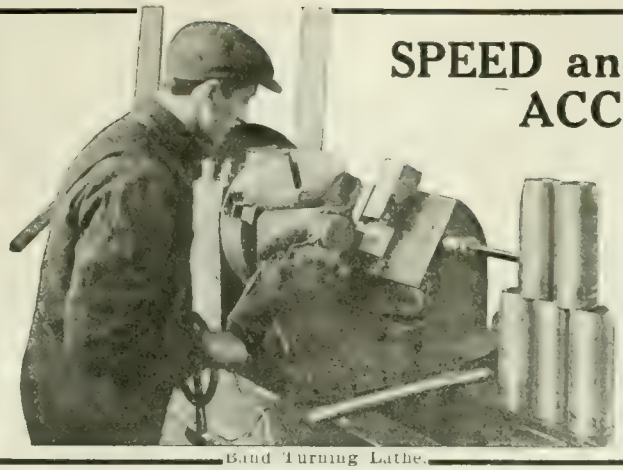
Jacks.
Can. Fairbanks-Morse Co., Montreal.
Northern Crane Works, Walkerville.
Norton, A. O., Coaticook, Que.
Plessisville Foundry, Plessisville, Que.

Jacks, Pneumatic.
Northern Crane Works, Walkerville.

Jacks, Pit and Track.
Can. Fairbanks-Morse Co., Montreal.
Northern Crane Works, Walkerville.
Watson-Stillman Co., Aldene, N.J.

Japanning Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Jaws, Face Plate.
Cushman Chuck Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.



Band Turning Lathe.

SPEED and ACCURACY

The two most important factors in the machining of shrapnel and 4.5 shells, speed and accuracy, can be achieved when turning copper bands by using this machine.

The cut at the left shows an operator turning copper bands on our machine. **His daily output averages 40 to 45 shells per hour.**

This lathe was designed and built by us especially for this work. It is of sufficiently heavy construction to enable it to stand up under the strenuous work demanded of shell-making machinery.

Most of the largest manufacturers have found it profitable to adopt it. Let us tell you why. We invite your inquiry.

The Jenckes Machine Co., Limited

Sherbrooke, Quebec

Branches at Toronto, Ontario, 728 Traders Bank Bldg.
Montreal, Que., 303 E. T. Bank Building.
St. Catharines, Ont.; Cobalt, Ont.; Vancouver, B.C.; Nelson, B.C.

ARMSTRONG WHITWORTH OF CANADA

LIMITED

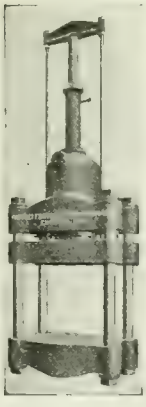
MANUFACTURERS OF CELEBRATED BRANDS OF

HIGH SPEED STEEL & DRILLS

"AW" FOR CUTTING ALL METALS AT HIGH SPEEDS

FOR HARD METALS — RAILWAY & TRAM TYRES "TYR"

OFFICE 22 VICTORIA SQ. MONTREAL — WORKS LONGUEUIL QUE.



ELMES HYDRAULIC PRESSES

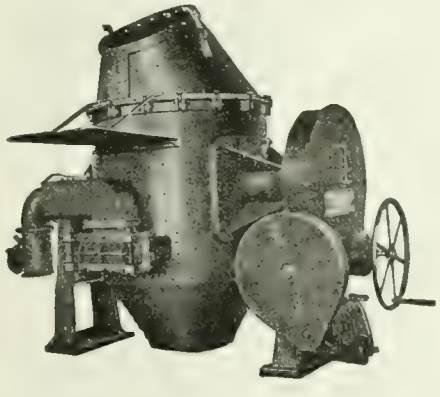
Rapid-acting hydraulic drawing presses, piercing presses, pumps, and accumulators for making Shells, etc. High pressure fittings and valves, quick shipment.

Send for our illustrated catalog to-day.

Charles F. Elmes Engineering Works

217 N. Morgan Street, Chicago, U.S.A.

Over 50 years' experience building hydraulic machinery.



THE WHITING CONVERTER

enables any foundry to make its own steel castings of whatever grade or analysis desired

A uniform product, reduced pattern expense and castings when wanted are only some of the big advantages gained

Write to-day for catalog No. 106.

Complete Foundry Equipments

WHITING
FOUNDRY EQUIPMENT CO.
HARVEY-ILL. U.S.A.
CHICAGO SUBURB.

Cranes of all Kinds

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Jigs, Tools, etc.
Hamilton Gear & Machine Co., Toronto.

Key Seaters.
Baker Bros., Toledo, O.
W. P. Davis Machine Co., Rochester, N.Y.
Garvin Machine Co., New York.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, Philadelphia, Pa.
A. R. Williams Machy. Co., Toronto.

Kilns.
Can. Buffalo Forge Co., Montreal.
Sheldons, Limited, Galt, Ont.

Lacquering Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Lacing, Belt.
Chicago Rawhide Mfg. Co., Chicago, Ill.

Ladles, Foundry.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Lag Screw Gimlet Pointers.
National Machy. Co., Tiffin, Ohio.

Lamps, Arc and Incandescent.
Can. Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Ker & Goodwin, Brantford.

Lathe Chucks.
Ker & Goodwin, Brantford.

Lathe Attachment for Shells.
Lymburner, Ltd., Montreal.

Lathes, Automatic.
Windsor Machine Co., Windsor, Vt.

Lathe Dogs and Attachments.
Armstrong Bros. Tool Co., Chicago.
Bridgeford Machine Tool Works, Rochester, N.Y.
Fay & Scott, Dexter, Maine.
Hendey Machine Co., Torrington, Conn.
J. H. Williams Co., Brooklyn, N.Y.

Lathes, Bench.
W. F. & John Barnes Co., Rockford.
Blount, J. G., & Co., Everett, Mass.
Can. Fairbanks-Morse Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.

Lathes, Engine.
A. R. Williams Machy. Co., Toronto.
Barnes Drill Co., Rockford, Ill.
W. F. & John Barnes Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Bridgeford Machine Tool Works, Rochester, N.Y.
Can. Fairbanks-Morse Co., Montreal.
Cincinnati Iron & Steel Co., Cincinnati, O.
W. P. Davis Machine Co., Rochester, N.Y.
Fay & Scott, Dexter, Maine.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
R. McDougall Co., Galt.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rahn-Larmon Co., Cincinnati, O.

Lathes, Extension Gap.
Barnes Drill Co., Rockford, Ill.

Lathe Pans.
New Britain Machine Co., New Britain, Conn.

Lathes, Patternmakers'.
J. G. Blount Co., Everett, Mass.
Fay & Scott, Dexter, Maine.
Mussens, Limited, Montreal.

Lathes, Screw Cutting.
A. R. Williams Machy. Co., Toronto.
Barnes Drill Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Cincinnati Iron & Steel Co., Cincinnati, O.
Girard Machine & Tool Co., Philadelphia, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles Bement Pond Co., New York.

Lathes, Spinning.
Bliss, E. W., Co., Brooklyn, N.Y.
Toledo Mach. & Tool Co., Toledo, O.

Lathe, Turret and Speed.
Acme Machine Tool Co., Cincinnati, O.
John Bertram & Sons Co., Dundas.
Blount, J. G., & Co., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Cincinnati Iron & Steel Co., Cincinnati, O.
Colburn Machine Tool Co., Franklin, Pa.
W. P. Davis Machine Co., Rochester
Fay & Scott, Dexter, Maine.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
New Britain Machine Co., New Britain, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rahn-Larmon Co., Cincinnati, O.
A. O. Walworth & Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, O.
Windsor Machine Co., Windsor, Vt.
A. R. Williams Machy. Co., Toronto.

Leather, Cup.
Chicago Rawhide Mfg. Co., Chicago, Ill.

Leather, Pump, Valve, Hydraulic, Etc.
Chicago Rawhide Mfg. Co., Chicago, Ill.

Leather Strapping.
Graton & Knight Mfg. Co., Montreal.

Lifts, Pneumatic.
Whiting Foundry Equipment Co., Harvey, Ill.

Link Belting.
Can. Fairbanks-Morse Co., Montreal.
Graton & Knight Mfg. Co., Montreal.
Jones & Glassco, Montreal.

Linoleum Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.

Liquid Air.
L'Air Liquide Society, Montreal, Toronto.

Lockers, Steel Wardrobe and Steel Material.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Lockers.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Locomotive Equipment.
Can. Locomotive Co., Kingston, Ont.

Locomotives, Railroading, Contracting.
Can. Locomotive Co., Kingston, Ont.
National Machinery & Supply Co., Hamilton.

Locomotives, Turn Tables.
Can. Bridge Co., Walkerville, Ont.

Lubricants.
Can. Economic Lubricant Co., Montreal.
Cataract Refining Co., Toronto.
Commercial Oil Co., Hamilton, Ont.

Machine Divided Rules.
Lufkin Rule Co., Saginaw, Mich.

Machine Tools.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Modern Tool Co., Erie, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Machinery Dealers.
Can. Fairbanks-Morse Co., Montreal.
National Machinery & Supply Co., Hamilton.
A. R. Williams Machy. Co., Toronto.

Machinery Guards.
Jones & Glassco, Montreal, P.Q.
Canada Wire & Iron Goods Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Machinery Repairs.
Cunningham & Sons, St. Catharines, Ont.
Plessisville Foundry, Plessisville, Que.

Machinists' Scales, Small Tools and Supplies.
Can. Fairbanks-Morse Co., Montreal.
Frank H. Scott, Montreal.
J. H. Williams & Co., Brooklyn, N.Y.

Mandrels.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Marine Engines.
Cunningham & Sons, St. Catharines, Ont.

Marking Machinery.
Holton Morgan Co., Toronto.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Marquises.
Dennis Wire & Iron Works, London, Ont.

Measuring Tapes and Rules.
James Chesterman & Co., Ltd., Sheffield Eng.
Lufkin Rule Co., of Canada, Windsor, Ont.

Mechanical Engineers.
Hooper-Falkenau Eng. Co., New York.

Metallurgists.
Toronto Testing Laboratory, Ltd., Toronto.

Metal Cutting Machines.
Racine Tool & Machine Co., Racine, Wis.

Metal Stamping.
Duncan Electrical Co., Montreal.

Meters, Electrical.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Mill Machinery.
Cunningham & Sons, St Catharines, Ont.
Alexander Fleck, Ltd., Ottawa.

Milling Attachments.
John Bertram & Sons Co., Dundas.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Machine Co., Cincinnati.
Hendey Mach. Co., Torrington, Conn.
Kearney & Trecker Co., Milwaukee.
Kempsmith Mfg. Co. Milwaukee, W.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.

Milling Machines, Horizontal and Vertical.
A. R. Williams Machy. Co., Toronto.
Brown & Sharpe Mfg. Co., Providence.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
John Bertram & Sons Co., Dundas.
Girard Machine & Tool Co., Philadelphia, Pa.
Gooley & Edlund, Cortland, N.Y.
Kearney & Trecker Co., Milwaukee.
Kempsmith Mfg. Co., Milwaukee, W.
Motch & Merryweather Machy. Co., Cleveland, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Crescent Oil Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.

Milling Machines, Keyseat.
Newton Machine Tool Works, Philadelphia, Pa.

Milling Machines, Multiple Spindle, Duplex, Etc.
Newton Machine Tool Works, Philadelphia, Pa.

Milling Machines, Plain, Bench and Universal.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cincinnati Milling Machine Co., Cincinnati.
Garvin Machine Co., New York.
Gooley & Edlund, Cortland, N.Y.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Hendey Machine Co., Torrington.
Kearney & Trecker Co., Milwaukee.
Kempsmith Mfg. Co., Milwaukee, Wis.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.
A. R. Williams Machy. Co., Toronto.

Milling Machines, Profile.
Brown & Sharpe Mfg. Co., Providence.
Can. Fairbanks-Morse Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Pratt & Whitney Co., Dundas, Ont.

Milling Tools.
Brown & Sharpe Mfg. Co., Providence.
Geometric Tool Co., New Haven, Conn.
Kempsmith Mfg. Co., Milwaukee, W.

Mine Cars and Hitchings.
Pratt & Whitney Co., Dundas, Ont.
Modern Tool Co., Erie, Pa.
Can. Fairbanks-Morse Co., Montreal.

Mining Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Mortising Machines.
Jones & Glassco, Montreal.

Motors, Electric.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Motors, Pneumatic.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Multiple Index Centres.
Garvin Machine Co., New York.

Nipple Threading Machines.
John H. Hall & Sons, Ltd., Brantford, Ont.
Landis Machine Co., Waynesboro, Pa.

Nitrogen.
L'Air Liquide Society, Montreal, Toronto.

Nozzles, Spray.
Can. Buffalo Forge Co., Montreal.

Nuts, Semi-Finish and Finished.
Galt Machine Screw Co., Galt, Ont.
John Morrow Screw Co., Ingersoll, Ont.

Nut Burring Machines.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Machines (Hot).
National Machy. Co., Tiffin, O.

Nut Facing and Bolt Shaving Machines.
Garvin Machine Co., New York.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Tappers.
John Bertram & Sons Co., Dundas.
Garvin Machine Co., New York.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Hall, J. H., & Son, Brantford, Ont.
A. B. Jardine & Co., Hespeler.
Landis Machine Co., Waynesboro, Pa.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Wrenches.
Wells Brothers Co., Greenfield, Mass.

Oil Separators.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.
Smart-Turner Machine Co., Hamilton, Ont.

Oil Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Oils, Lubricating, Tempering.
Commercial Oil Co., Hamilton, Ont.

Ovens for Baking, Bluing, Drying, Enamelling, Japanning, and Lacquering.
Geo. Gorton Machine Co., Racine, Wis.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Oven Trucks, Steel.
Oven Equipment & Mfg. Co., New Haven, Conn.

Ovens for Drying, Temper and Under Trucks.
Oven Equipment & Mfg. Co., New Haven, Conn.

Oscillating Valve Grinders (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Oxy-Acetylene Welding and Cutting Plants.
L'Air Liquide Society, Montreal, Toronto.

Oxygen.
L'Air Liquide Society, Montreal, Toronto.

Packings, Leather, Hydraulics, Etc.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Graton & Knight Mfg. Co., Montreal.

Packing, Rubber, etc.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Pans, Lathe.
Cleveland Wire Spring Co., Cleveland

Pans, Steel Shop.
Cleveland Wire Spring Co., Cleveland

Paper Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.
Can. Sirocco Co., Ltd., Windsor, Ont.

Partitions.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Patent Solicitors.
H. J. S. Dennison, Toronto.
Fetherstonhaugh & Co., Ottawa.
Marion & Marion, Montreal.
Ridout & Maybee, Toronto.
Ross Thomson & Co., Ottawa, Ont.

Patterns.
Galt Malleable Iron Co., Galt.
Guelph Pattern Works, Guelph.
Hamilton Pattern & Foundry Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound, Ont.
Plessisville Foundry, Plessisville, Que.
Toronto Pattern Works, Toronto.
Wells Pattern & Machine Works, Toronto.

Patterns, Metal and Wood.
Guelph Pattern Works, Guelph, Ont.

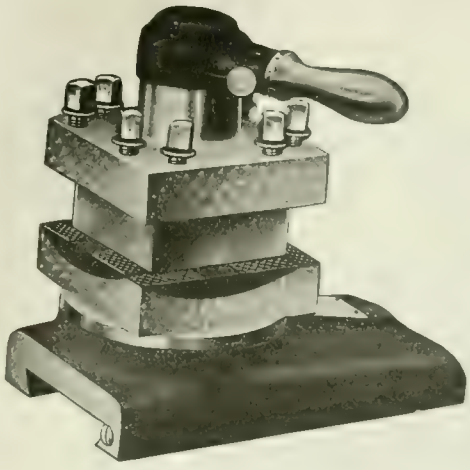
Perforated Metals and Ornamental Iron Goods.
Canada Wire & Iron Goods Co., Hamilton.

Penstocks.
Polson Iron Works, Toronto.

Phosphor Bronze Castings.
Tallman Brass & Metal Co., Hamilton.

Pig Iron.
Hanna & Co., M. A., Cleveland, O.
Stevens, F. B., Detroit, Mich.

Pinions, Mill Cut.
Wm. Tod Co., Youngstown, O.



Particularly Adapted to the Manufacture of Shrapnel

Your Lathe Needs A NEW TOOL POST. One of the Modern Multiple Type.

You can no longer afford to use the old style single tool holder.

Give us the size of the dovetail on your lathe carriage and height to lathe center; we will quote you price on a Modern Tool Holder that we guarantee will increase your production, and give you some interesting facts about Lathe Turrets.

No matter what make or size of lathe—we can fit it.

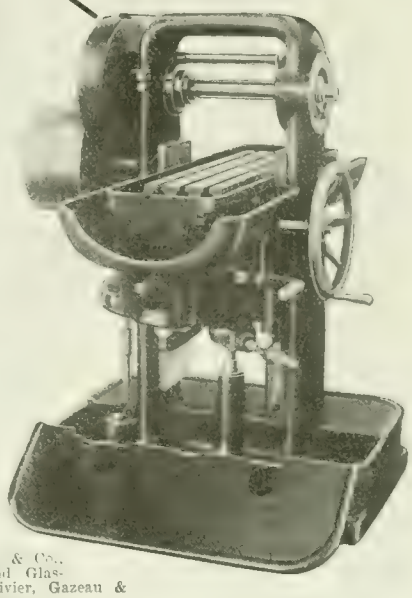
Fay & Scott, Dexter, Me.

The "BRIGGS" Miller

Just in its element in heavy, fast and accurate production

Increased the production for the Reo Motor Car Co. from 8 to 20 per hour, as compared with methods previously used.

The work is slotting the fork end of the gear 1⅛" wide by 1½" deep. Material 50-point carbon steel drop forgings. Eight blanks held in the fixture, the spindle carrying two cutters and finishing four blanks, at the same time four more were being roughed.



WRITE FOR MORE DETAILS

GOOLEY & EDLUND

Inc.

Cortland, U.S.A.

FOREIGN AGENTS Allied Machinery Company of America, France, Belgium, Italy, Switzerland Russia, Scandinavia C. W. Burton, Griffiths & Co., London Manchester and Glasgow. Barandiaran, Metivier, Gazeau & Cia, San Sebastian, Spain.

DRIVING 2½ in. DRILL, WORKING IN DROP-FORGED, WROUGHT-IRON SADDLES.

These were 2 3-4 in. thick and were drilled from the solid in 37 1-2 seconds.

IT'S A BAKER

The convenience, rigidity and power of BAKER HIGH-SPEED DRILLING MACHINES give them unequalled production possibilities on **drilling, boring, reaming, counterboring, facing, undercutting, box milling, tapping.**

Baker drills will drive 3-inch high-speed drills to the limit of their efficiency in steel.

THE BAKER IS INVALUABLE IN SHELL MAKING because of its accuracy and dependability, low cost of operation and low installation cost.

Eight speed and twelve feed changes within easy reach of operator.

Our catalog is worth your having. Drop a line for it.

BAKER BROTHERS

TOLEDO, OHIO, U.S.A.

Canadian Agents: The A.R. Williams Machinery Company Limited, Toronto, Canada

Pipe Cutting and Threading Machines.
A. R Williams Machy. Co., Toronto.
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Butterfield & Co., Rock Island ,Que.
Can. Fairbanks-Morse Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
John H. Hall & Sons, Brantford.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro. Pa.
R. McDougall Co., Galt.
Trimont Mfg. Co., Roxbury, Mass.
Williams Tool Co., Erie, Pa.

Pipe Cutters, Rolling.
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
John H. Hall & Sons, Ltd., Brantford, Ont.

Pipe Straightening Machines.
Watson-Stillman Co., Aldene, N.J.

Planer Drives, Electrical.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
Niles-Bement-Pond Co., New York.

Planer Jacks.
Armstrong Bros. Tool Co., Chicago.

Planers, Standard and Rotary.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Planing and Shaping Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co, Montreal.
Detrick & Harvey Machine Co., Baltimore, Md
Fay & Scott, Dexter, Maine.
Garvin Machine Co., New York.
Niles-Bement-Pond Co., New York.

Planing Mill Exhausters.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Pliers.
Canadian Billings & Spencer, Ltd., Welland.
McKaig Drop Forge Co., Buffalo, N.Y.

Pneumatic Tools.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, New York.

Polishing Machines, Electric and Band.
Can. H. W. Johns-Manville Co., Toronto.

Portable Vise Stands.
New Britain Machine Co., New Britain, Conn.

Portable Steel Tool Racks.
New Britain Machine Co., New Britain, Conn.

Portable Steel Work Stands.
New Britain Machine Co., New Britain, Conn.

Power Plant Engineers.
Hooper-Falkenau Eng. Co., New York.

Power Plant Equipments.
Can. Fairbanks-Morse Co., Montreal.

Power Transmission.
The Smart-Turner Mach. Co., Hamilton.

Press Screw (Adjustable).
W. F. & John Barnes Co., Rockford.

Presses, Bench Straightening.
Toledo Machine & Tool Co., Toledo.

Presses for Shells.
Can. Boomer & Boschert Press Co., Montreal.
Can. Locomotive Co., Kingston, Ont.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
Charles F. Elmes Eng. Works, Chicago
Goldie & McCulloch Co., Galt, Ont.
Watson-Stillman Co., Aldene, N.J.
West Tire Setter Co., Rochester, N.Y.
R. D. Wood Co., Philadelphia, Pa.

Presses, Cam, Toggle, Eyelet.
Baird Machine Co., Bridgeport, Conn.
Toledo Machine & Tool Co., Toledo, O.

Presses, Broaching.
E. W. Bliss Co., Brooklyn, N.Y.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman & Co., Aldene, N.J.

Presses, Drop.
W. H. Banfield & Son, Toronto.
E. W. Bliss Co, Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Boomer & Boschert Press Co., Montreal.
Niles-Bement-Pond Co., New York.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.

Presses, Filter.
Lymburner, Ltd., Montreal.

Presses, Forging.
Can. Boomer & Boschert Press Co., Montreal.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
Charles F. Elmes Eng. Works, Chicago, Ill.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Wm. Tod Co., Youngstown, O.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.

Presses, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Charles F. Elmes Eng. Works, Chicago, Ill.
Hydraulic Press Co., Mt. Gilead.
Niles-Bement-Pond Co., New York.
Wm. Tod Company, Youngstown, O.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.
R. D. Wood Co., Philadelphia, Pa.

Presses, Pneumatic.
Toledo Machine & Tool Co., Toledo.

Presses, Power.
Baird Machine Co., Bridgeport, Conn.
Can. Boomer & Boschert Press Co., Montreal.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Can. Fairbanks-Morse Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Geo. Gorton Machine Co., Racine.
Girard Machine & Tool Co., Philadelphia, Pa.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.
A. R. Williams Machy. Co., Toronto.

Presses, Scrap Baling.
Can. Boomer & Boschert Press Co., Montreal.
Watson-Stillman Co., Aldene, N.J.

Presses, Spring Foot.
Baird Machine Co., Bridgeport, Conn.
Toledo Machine & Tool Co., Toledo.
Brown, Boggs & Co., Hamilton, Can.

Presses, Screw.
Can. Boomer & Boschert Press Co., Montreal.

Pressure Regulators.
Can. Fairbanks-Morse Co., Montreal.

Protective Paint.
Jos. Dixon Crucible Co., Jersey City.

Pulleys.
Baird Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R.I.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Positive Clutch & Pulley Works, Ltd., Toronto.
The Smart-Turner Mach. Co., Hamilton.

Pulley Machinery, Drilling and Tapping.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.

Pumps, High Pressure.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Pumping Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
The Smart-Turner Mach. Co., Hamilton.
Wm. Tod Company, Youngstown, O.

Pumps, all Kinds.
Can. Buffalo Forge Co., Montreal.
Charles F. Elmes Eng. Works, Chicago
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
Owen Sound Iron Works Co., Owen Sound.
The Smart-Turner Mach. Co., Hamilton.
A. R. Williams Machy. Co., Toronto.
Watson-Stillman Co., Aldene, N.J.
Wayne Oil Tank & Pump Co., Fort Wayne.

Pumps, Electrically Driven.
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
The Smart-Turner Mach. Co., Hamilton.

Pumps, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Wm. Tod Co., Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Pumps, Steam.
Wm. Tod Company, Youngstown, O.

Pump Leathers.
Graton & Knight Mfg. Co., Montreal.

Punches and Dies.
W. H. Banfield & Sons, Toronto.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Scott Bros., Halifax, Eng.
Gardner, Robt., & Son, Montreal.
Globe Machine & Stamping Co.
A. B. Jardine & Co., Hespeler, Ont.
Pratt & Whitney Co., Dundas, Ont.
Toledo Machine & Tool Co., Toledo, O.
A. O. Walworth & Co., Chicago, Ill.

Punches, Power.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Girard Machine & Tool Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., Aldene, N.J.
A. O. Walworth & Co., Chicago, Ill.

Punches, Pneumatic.
Jno. F. Allen Co., New York.

Punching Machines, Horizontal.
Bertrams, Ltd., Edinburgh, Scotland.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Long & Alstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Pyrometers.
Brown Instrument Co., Philadelphia, Pa.
Canadian Hoskins, Limited, Walkerville, Ont.
Shore Instrument & Mfg. Co., New York City.
Thwing Instrument Co., Philadelphia, Pa.

Quartering Machines.
John Bertram & Sons Co., Dundas.
Niles-Bement-Pond Co., New York.

Ratchet Wrenches.
Wells Brothers Co., Greenfield, Mass.

Railing, Iron and Brass.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Rail Benders.
Niles-Bement-Pond Co., New York.

Railroad Tools.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.

Railroad Tools, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Rammers, Bench and Floor.
Guelph Pattern Works, Guelph, Ont.

Rapping Plates.
Stevens, F. B., Detroit, Mich.

Ratchets.
Keystone Mfg. Co., Buffalo, N.Y.

Raw Hide Pinions.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Gardner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

Reamers, Adjustable.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wells Brothers Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.

Reamers, Bridge, Expanding and High Speed.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Reamer Fluting Machines.
Garvin Machine Co., New York.

Reamers, Pipe, Cylinder and Locomotive.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Reaming Machines, Pneumatic.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Reamers, Steel Taper and Self-Feeding.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Rebuilt Machine Tools.
New York Machy. Co., New York.

Reels.
Baird Machine Co., Bridgeport, Conn.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Revolution Indicators and Recorders.
Brown Instrument Co., Philadelphia, Pa.

Rheostats.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Rivet Machines.
Buffalo Forge Co., Buffalo, N.Y.
National Machinery Co., Tiffin, O.

Rivets, Tubular, Bifurcated.
Parmenter & Bulloch Co., Gananoque.

Rivets, Iron, Copper and Brass.
Parmenter & Bulloch Co., Gananoque.

Riveters, Pneumatic, Hydraulic. Hammer, Compression.
Jno. F. Allen Co., New York.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co. of Chicago, Ill.
National Mach. & Sup. Co., Hamilton
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., Aldene, N.J.

Riveting Machines, Elastic Rotary Blow.
Girard Machine & Tool Co., Philadelphia, Pa.
High-Speed Hammer Co., Rochester, N.Y.
F. B. Shuster Co., New Haven, Conn.

Rolls, Bending.
John Bertram & Sons Co., Dundas, Ont
Brown, Boggs Co., Ltd., Hamilton, Canada.
Niles-Bement-Pond Co., New York.
Toledo Machine & Tool Co., Toledo.

Rolling Mill Machinery.
Wm. Tod Co., Youngstown, O.

Roofing.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Rotary Converters.
A. R. Williams Machy. Co., Toronto.
Toronto and Hamilton Electric Co., Hamilton.

Rubber Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Rules.
Brown & Sharpe Mfg. Co., Providence, R.I.
James Chesterman & Co., Ltd., Sheffield, Eng.
L. S. Starrett Co., Athol, Mass.

Safety Set Screws.
Allen Mfg. Co., Inc., Hartford, Conn.

Sand Blasts.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Gray Mfg. & Machine Co., Toronto.
W. W. Sly Mfg. Co., Cleveland, O.

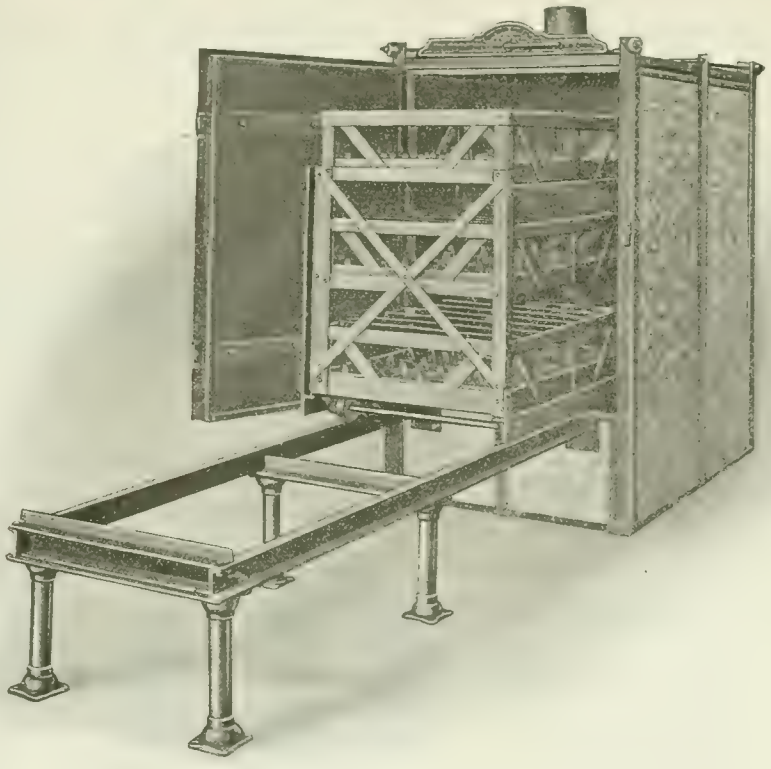
Saw Blades.
Diamond Saw & Stamping Works, Buffalo, N.Y.
Huther Bros. Saw Mfg. Co., Rochester, N.Y.

Saw Tables.
Hub Machine Welding & Contracting Co., Philadelphia, Pa.

Saw Sharpening Machines.
Nutter & Barnes Co., Hinsdale, N.H.

Saw Mill Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Gardner, Robt. & Son, Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Espen-Lucas Machine Works, Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
Plessisville Foundry, Plessisville, Que.

Sawing Machines, Cold Metal.
Newton Machine Tool Works, Philadelphia, Pa.



Another type of Crawford Sectional Oven used in baking the varnish or finish on Shrapnel and High Explosive Shells to prevent corrosion.

All ovens are equipped with enclosed flame gas burners which protect the coating to be baked from coming in direct contact with the flame. Either city, natural, gasoline or producer gas can be used with this equipment.

By the above method of burning the gas and at the same time providing the necessary circulation of air in the oven through the use of a positive pressure blower, we support combustion of the gas within the generator by confining the gas and air, thereby obtaining perfect combustion and all of the heat units from the gas with no by-products to affect the smoothness or texture of the coating.

The truck shown with this oven is designed with three independent racks, each holding thirty-five, thirty-four-pound shells, about five inches diameter, and fourteen inches long,—each rack being run into the truck separately and loaded, total load being one hundred and five shells,—ovens and trucks built for any number or size of shells required.

The Oven Equipment & Manufacturing Company

NEW HAVEN, CONN.

Canadian Representatives: THE A. R. WILLIAMS MACHINERY CO., LIMITED, TORONTO, CANADA

Saws, High-Speed, Friction.
Espen-Lucas Machine Works, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Hunter Saw & Machine Co., Pittsburg, Pa.
Nutter & Barnes Co., Hinsdale, N.H.

Saws, Inserted Tooth.
Earle Gear & Machine Co., Philadelphia, Pa.
Espen-Lucas Machine Works, Philadelphia, Pa.
Huther Bros. Saw Mfg. Co., Rochester, N.Y.
Q. M. S. Co., Chicago, Ill.
Tabor Mfg. Co., Philadelphia, Pa.

Saws, Hack.
Can. Fairbanks-Morse Co., Montreal.
Diamond Saw & Stamping Works, Buffalo.
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
L. S. Starrett Co., Athol, Mass.

Saws, Circular Metal.
Earle Gear & Machine Co., Philadelphia, Pa.
Espen-Lucas Machine Works, Philadelphia, Pa.
Hub Machine Welding & Contracting Co., Philadelphia, Pa.
Hunter Saw & Machine Co., Pittsburg, Pa.
Huther Bros. Saw Mfg. Co., Rochester, N.Y.
Tabor Mfg. Co., Philadelphia, Pa.

Saws, Hot and Cold.
Earle Gear & Machine Co., Philadelphia, Pa.
Hunter Saw & Machine Co., Pittsburg, Pa.
Huther Bros. Saw Mfg. Co., Rochester, N.Y.
Nutter & Barnes Co., Hinsdale, N.H.
Q. M. S. Co., Chicago, Ill.
Vulcan Eng. Sales Co., Chicago, Ill.

Scleroscopes.
Shore Instrument & Mfg. Co., New York City.

Screws, Caps and Set.
Galt Machine Screw Co., Galt, Ont.
John Morrow Screw Co., Ingersoll, Ont.

Screw Machine Products.
Galt Machine Screw Co., Galt, Ont.
John Morrow Screw Co., Ingersoll, Ont.

Screw Machines, Hand, Automatic.
Acme Machine Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
A. B. Jardine & Co., Hespeler.
Mofch & Merryweather Machy. Co., Cleveland, O.
National Mach. & Sup. Co., Hamilton.
New Britain Machine Co., New Britain, Conn.
Pratt & Whitney Co., Dundas, Ont.
A. O. Walworth & Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, O.
A. R. Williams Machy. Co., Toronto.
Windsor Machine Co., Windsor, Vt.

Screw Machines, Multiple Spindle.
New Britain Machine Co., New Britain, Conn.
Windsor Machine Co., Windsor, Vt.

Screw Plates.
Butterfield & Co., Rock Island, Que.
Can. Tap & Die Co., Galt, Ont.
A. B. Jardine & Co., Hespeler.
Morse Twist Drill & Machine Co., New Bedford.
Wells Brothers Co., Greenfield, Mass.
Wiley & Russell Co., Greenfield, Mass.

Screw Slotters.
Garvin Machine Co., New York.
Pratt & Whitney Co., Dundas, Ont.

Set Screws, Safety.
Allen Mfg. Co., Hartford, Conn.

Second-Hand Machinery.
New York Machinery Co., New York.
Gardner, Robt. & Son, Montreal.
Can. Drawn Steel Co., Hamilton, Ont.
Gardner, Robt. & Son, Montreal.
National Mach. & Sup. Co., Hamilton.
Niles Bement Pond Co., New York.
Plessisville Foundry, Plessisville, Que.
The Smart-Turner Machine Co., Hamilton.
Union Drawn Steel Co., Hamilton.

Shanks, Straight and Taper.
Jacobs Mfg. Co., Hartford, Conn.

Shapers.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
W. P. Davis Machine Co., Rochester, N.Y.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Hendey Machine Co., Torrington, Ct.
Hill, Clarke & Co., of Chicago, Chicago, Ill.

Shafting.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Stockbridge Machine Co., Worcester, Mass.

Sharpening Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Shavings, Separators.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Shearing Machines, Angle Iron, Bar and Gate.
John Bertram & Sons Co., Dundas.
Bertrams, Ltd., Edinburgh, Scotland.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler.
Long & Alstatter, Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Scott Bros., Halifax, Eng.
Toledo Machine & Tool Co., Toledo.

Shears, Power.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown Boggs Co., Ltd., Hamilton, Canada.
Buffalo Forge Co., Buffalo, N.Y.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machy. Co., Tiffin, Ohio.
National Mach. & Sup. Co., Hamilton.
Niles-Bement-Pond Co., New York.
Scott Bros., Halifax, Eng.
Toledo Machine & Tool Co., Toledo.

Shears, Lever, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Shears, Pneumatic.
John F. Allen Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.

Shears, Squaring.
Brown, Boggs, & Co., Hamilton, Can.

Sheet Steel.
Dom. Sheet Metal Co., Hamilton, Ont.

Sheet Metal Working Tools.
Baird Machine Co., Bridgeport, Conn.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Steel Bending Brake Works, Ltd., Chatham, Ont

Sheet Metal Stampings.
Duncan Electrical Co., Montreal.

Shell Banding Machines, Hydraulic.
Can. Locomotive Co., Kingston, Ont.
Lymburner, Ltd., Montreal.
Mofch & Merryweather Machy. Co., Cleveland, O.
Watson-Stillman Co., Aldene, N.J.
West Tire Setter Co., Rochester, N.Y.

Shell Painting Machine.
Can. Locomotive Co., Kingston, Ont.

Shell Screws, Headless.
Blake & Johnson, Waterbury, Conn.

Shelving, Steel Partitions.
Canadian Steel Products Company, Montreal.

Shrapnel Shell Forging, Drilling Machines.
Barnes Drill Co., Rockford, Ill.

Shrapnel Shell Marker.
Brown-Boggs Co., Hamilton, Ont.
Holden-Morgan Co., Toronto
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pangborn Corporation, Hagerstown, Md.

Shrapnel Sand Blasts.
Pangborn Corporation, Hagerstown, Md
W. W. Sly Mfg. Co., Cleveland, O.

Side Tools.
Armstrong Bros. Tool Co., Chicago.

Slotters.
Garvin Machine Co., New York.
Niles-Bement-Pond Co., New York.

Smokestacks.
Plessisville Foundry, Plessisville, Que.
Polson Iron Works, Toronto.

Sockets.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cleveland Twist Drill Co., Cleveland.
Keystone Mfg. Co., Buffalo, N.Y.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Soldering Irons.
Brown Boggs & Co., Hamilton, Can.

Solders.
Tallman Brass & Metal Co., Hamilton.

Special Machinery.
Armstrong Bros., Toronto.
W. H. Banfield & Sons, Toronto.
John Bertram & Sons Co., Dundas.
Baird Machine Co., Bridgeport, Conn
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Can. Fairbanks-Morse Co., Montreal.
Canada Machy. Agency, Montreal.
Cunningham & Sons, St. Catharines, Ont.
Charles F. Elmes Eng. Works, Chicago
Detrick & Harvey Machine Co., Baltimore, Md.
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
Gooley & Edlund, Inc., Courtland, N.Y.
John H. Hall & Sons, Brantford.
Jardine, A. B., & Co., Hespeler.
National Mach. & Sup. Co., Hamilton.
Plessisville Foundry, Plessisville, Que.
Smart-Turner Machine Co., Hamilton, Ont.
Wm. Tod Company, Youngstown, O.

Spike Machines.
The Smart-Turner Machine Co., Hamilton.

Spring Coilers.
Baird Machine Co., Bridgeport, Conn.
Garvin Machine Co., New York.

Springs, Machinery.
Cleveland Wire Spring Co., Cleveland.
Jas. Steele, Ltd., Guelph, Ont.

Spring Making Machinery (Automatic).
Baird Machine Co., Bridgeport, Conn.

Sprockets, Chain.
Morse Chain Co., Ithaca, N.Y.
Philadelphia Gear Works, Philadelphia, Pa.

Stairs, Iron.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Stamping.
Duncan Electrical Co., Montreal.

Stamping Machinery.
Homer & Wilson, Hamilton, Ont.
Brown, Boggs & Co., Hamilton, Can.

Stay-Bolt Driver.
Independent Pneumatic Tool Co., Chicago.

Stand Pipes.
Polson Iron Works, Toronto.

Stationary Ladders.
New Britain Machine Co., New Britain, Conn.

Steam Specialties.
Sheldons, Ltd., Galt, Ont.

Steam Separators and Traps.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.
The Smart-Turner Machine Co., Hamilton.

Steel Alloy.
Vanadium Alloys Steel Co., Pittsburgh, Pa.

Steel Chains for Pulp Mill and Saw Mill.
Plessisville Foundry, Plessisville, Que.

Steel Bench Legs.
New Britain Machine Co., New Britain, Conn.

Steel Bending Brakes.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Steel, Cold Rolled.
Can. Drawn Steel Co., Hamilton, Ont.
Union Drawn Steel Co., Hamilton, Ont.

Steel Pressure Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Steel, all kinds.
Can. Bridge Co., Walkerville, Ont.

Steel, High Speed.
Armstrong Whitworth of Canada, Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
H. A. Drury Co., Ltd., Montreal.
Thos. Firth & Sons, Montreal.
National Mach. & Sup. Co., Hamilton.
Vanadium Alloys Steel Co., Pittsburg, Pa.

Steel Die Engraving.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Steel Vanadium.
Vanadium Alloys Steel Co., Pittsburgh, Pa.

Stocks for Dies.
Wells Bros. Co., Greenfield, Mass.

Stocks, Pipe.
Butterfield & Co., Rock Island, Que.
Greenfield Tap & Die Corporation, Greenfield, Mass.

Stools, Steel, Shop.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Stock Racks for Bars, Piping, Etc.
New Britain Machine Co., New Britain, Conn.

Straight Edges.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Straightening Machinery.
Baird Machine Co., Bridgeport, Conn.
Bertrams, Ltd., Edinburgh, Scotland
National Mach. & Sup. Co., Hamilton.

Structural Steel.
Hamilton Bridge Works Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound, Ont.

Studs.
Galt Machine Screw Co., Galt, Ont.
John Morrow Screw Co., Ingersoll, Ont.

Stud Driver.
Keystone Mfg. Co., Buffalo, N.Y.

Switchboards.
Toronto & Hamilton Electric Co., Hamilton.

Switches, Railway.
National Mach. & Sup. Co., Hamilton.

Tachometers.
Brown Instrument Co., Philadelphia, Pa.

Tanks, Oil.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

Tanks, Steel.
John Inglis Co., Toronto.
Plessisville Foundry, Plessisville, Que.
Polson Iron Works, Toronto.

Tapes, Measuring.
Lufkin Rule Co., Windsor, Ont.
James Chesterman & Co., Ltd., Sheffield, Eng.

Tapes, Friction.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Tapping Machines (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.

Tapping Machines and Attachments.
Baker Brothers, Toledo, O.
John Bertram & Sons Co., Dundas.
Garvin Machine Co., New York.
The Geometric Tool Co., New Haven
Girard Machine & Tool Co., Philadelphia, Pa.
Greenfield Tap & Die Corporation, Greenfield, Mass.
J. H. Hall & Sons, Brantford, Ont.
A. B. Jardine & Co., Hespeler.
Landis Machine Co., Waynesboro, Pa.
Manufacturers Equipment Co., Chicago, Ill.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.
Niles-Bement-Pond Co., New York.
L. S. Starrett Co., Athol, Mass.

Tap Chucks.
Wells Bros., Greenfield, Mass.

Taps, Adjustable.
Geometric Tool Co., New Haven.
Manufacturers Equipment Co., Chicago, Ill.
Murchey Machine & Tool Co., Detroit.

Taps, Dies and Wrenches.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Can. Tap & Die Co., Galt, Ont.
Cleveland Twist Drill Co., Cleveland
Geometric Tool Co., New Haven, Conn.
A. B. Jardine & Co., Hespeler.
Morse Twist Drill & Machine Co., New Bedford.
Murchey Machine & Tool Co., Detroit.
Pratt & Whitney Co., Dundas, Ont.
L. S. Starrett Co., Athol, Mass.
Wiley & Russell Co., Greenfield, Mass.
Wells Brothers Co., Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Technical Books.
The MacLean Publishing Co., Ltd., Toronto.

Testing Instruments, Metallurgical.
Shore Instrument & Mfg. Co., New York City.

Testing Laboratories.
Toronto Testing Laboratory, Toronto.

Thread Cutting Machines.
Can. Fairbanks-Morse Co., Montreal.
Garvin Machine Co., New York.
Geometric Tool Co., New Haven, Conn.
Girard Machine & Tool Co., Philadelphia, Pa.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Pratt & Whitney Co., Dundas, Ont.
National Machy. Co., Tiffin, Ohio.
Wiley & Russell Co., Greenfield, Mass.

Thread Milling Machines.
Holden-Morgan Co., Toronto.

Thermometers, Indicating and Recording.
Brown Instrument Co., Philadelphia Pa.

Time Clocks.
International Time Recording Co Toronto.

AUTOMATIC
WOOD SCREW MACHINES

Cable Address:
Cook, Hartford, U.S.A.

Asa S. Cook Co.

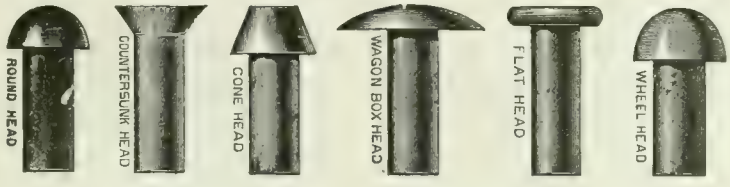
Hartford,
Conn.

NORTHERN CRANE WORKS, Limited
WALKERVILLE, ONT.

BUY IN CANADA!

NORTHERN CRANES

ELECTRIC AND HAND POWER
ALL SIZES, CAPACITIES AND TYPES
ALSO ELECTRIC AND AIR HOISTS
Foundry Equipment—Cupolas, Ladles, Etc.



WE MANUFACTURE RIVETS of every description, ½ inch. dia. and smaller.

PARMENTER & BULLOCH CO., LTD.
GANANOQUE, ONT.

"Victoria"
PIG IRON
Foundry
Soft and Strong
Malleable

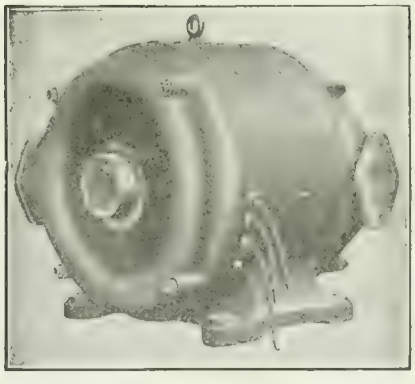
Shipments from
The Canadian Furnace Co.,
Port Colborne, Ont.

M.A. HANNA & Co.
Sales Agents Cleveland

M·A HANNA & Co

The Lancashire Dynamo & Motor Company, of Canada, Limited
107-109 Duke Street, TORONTO

ELECTRICAL MACHINERY for all Purposes.
ELLIOTT BROS'. { INSTRUMENTS / RECORDING GAUGES



PIPE VENTILATED A C MOTOR
FOR VERY DIRTY PLACES

Tinsmiths' Tools.
Brown, Boggs & Co., Hamilton, Can.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Tire Setting Machines, Hydraulic.
West Tire Setter Co., Rochester, N.Y.

Tire, Wheels.
Wells Bros. Co., Greenfield, Mass.

Toolmakers' Files.
American Swiss File & Tool Co., New York.

Tool Boxes, Steel.
Can. Steel Products Co., Montreal.

Tool Holders.
Armstrong Bros. Tool Co., Chicago.
Cleveland Twist Drill Co., Cleveland.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Dundas, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Tool Room Partitions.
Can. Wire & Iron Goods Co., Hamilton.

Tool Posts, Lathe.
Armstrong Bros. Tool Co., Chicago.

Tool Steel.
Armstrong, Whitworth, Ltd., of Canada, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Thos. Firth & Sons, Montreal.
National Mach. & Sup. Co., Hamilton.

Tools, Blacksmiths', Etc.
A. R. Williams Machy. Co., Toronto.

Tools, Electrical.
A. R. Williams Machy. Co., Toronto.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
United States Elec. Tool Co., Cincinnati, O.

Tools, Grinding, Milling, Drilling, Etc.
Newton Machine Tool Works, Inc., Philadelphia, Pa.

Tools, Lathe, Planer and Slotter.
Armstrong Bros. Tool Co., Chicago.

Torches, Steel.
Stevens, F. B., Detroit, Mich.
Armstrong, Whitworth of Canada, Ltd., Montreal.

Track Bits.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Track Systems.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Track Tools.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.

Transformers and Converters.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Drawn Steel Co., Hamilton, Ont.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Hamilton Gear & Mach. Co., Toronto.
Jones & Glassco, Montreal.
D. K. McLaren, Montreal.
Morse Chain Co., Ithaca, N.Y.
Plessisville Foundry, Plessisville, Que.
The Smart-Turner Machine Co., Hamilton.

Transmission Towers.
Can. Bridge Co., Walkerville, Ont.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Northern Crane Works, Walkerville.
Tallman Brass & Metal Co., Hamilton.

Traveling Cranes.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Trolley Hoists, Electric.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks, Lumber and Kiln.
Sheldons, Ltd., Galt, Ont.
Northern Crane Works, Walkerville.

Trucks, Factory, Freight, Etc.
Chambers, Ltd., Toronto.
Chapman Double Ball Bearing Co., Toronto.
Toronto Type Foundry Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Tube Expanders (Rollers).
A. R. Jardine & Co., Hespeler.
Watson-Stillman Co., Aldene, N.J.

Tumbling Barrels.
Baird Machine Co., Bridgeport, Conn.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Turnbuckles.
Canadian Billings & Spencer, Ltd., Welland.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Turret Machines.
Acme Machine Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R.I.
W. P. Davis Machine Co., Rochester, N.Y.
Fay & Scott, Dexter, Me.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.

Valves, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Watson-Stillman Co., Aldene, N.J.
R. D. Wood & Co., Philadelphia, Pa.

Valve Leathers.
Graton & Knight Mfg. Co., Montreal.

Valves, Back Pressure, Steam.
Sheldons, Limited, Galt.

Vanadium Steel.
H. A. Drury Co., Ltd., Montreal.

Ventilating Apparatus.
Can. Sirocco Co., Ltd., Windsor, Ont.
Pangborn Corporation, Hagerstown, Md.
Sheldons, Limited, Galt.
A. R. Williams Machy. Co., Toronto.

Vises, Bench.
Emmert Mfg. Co., Waynesboro, Pa.
Hollands Mfg. Co., Erie, Pa.

WHEN you need new equipment or supplies for your machine shop

Consult this Directory

¶ You'll find listed here the reliable makers of the lines you need; firms who believe in the progressiveness of present-day manufacturers and who appeal to their intelligence through their own engineering journal.

¶ Consult Canadian Machinery Buyers' Directory and you can't go wrong in your buying.

New Britain Machine Co., New Britain, Conn.
Pratt & Whitney, Hartford, Conn.
Turner Machine Co., Ltd., Danbury, Conn.
Warner & Swasey, Cleveland, O.

Turbines, Steam, Water.
Plessisville Foundry, Plessisville, Que.

Upsetting and Bending Machinery.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Brown, Boggs Co., Ltd., Hamilton, Canada.
A. R. Jardine & Co., Hespeler.
National Machy. Co., Tiffin, O.
Niles Bement Pond Co., New York.
Watson-Stillman Co., Aldene, N.J.

Vacuum Pumps.
Buffalo Forge Co., Buffalo, N.Y.
Smart-Turner Machine Co., Hamilton, Ont.

Valve Grinders (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.

National Mach. & Sup. Co., Hamilton.
New Britain Machine Co., New Britain, Conn.

Vises, Pipe.
Armstrong Mfg. Company, Bridgeport, Conn.
Bignall & Keeler Mach. Works, Edwardsville, Ill.
Butterfield & Co., Rock Island, Que.
Emmert Mfg. Co., Waynesboro, Pa.
National Mach. & Sup. Co., Hamilton.
J. H. Williams Co., Brooklyn, N.Y.

Vises, Planer and Shaper.
Girard Machine & Tool Co., Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
Skinner Chuck Co., New Britain, C.

Vises, Milling Machine.
National Mach. & Sup. Co., Hamilton.

Vises, Woodworking.
Emmert Mfg. Co., Waynesboro, Pa.

Voltmeters.
Brown Instrument Co., Philadelphia, Pa.

Washers.
Chicago Rawhide Mfg. Co., Chicago, Ill.
Graton & Knight Mfg. Co., Worcester, Mass.
London Bolt & Hinge Works, London, Ont.

Washer Machines.
National Machy. Co., Tiffin, Ohio.

Waterproof Coating, Cement, Fabric.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Watchman's Clocks.
A. R. Williams Machy. Co., Toronto.

Wattmeters.
Brown Instrument Co., Philadelphia, Pa.

Welding and Cutting Clamps.
Can. Blaugas Co., Ltd., Montreal.
L'Air Liquide Society, Toronto.

Welding and Cutting Work.
Can. Blaugas Co., Ltd., Montreal.
L'Air Liquide Society, Toronto.
Metals Welding Co., Cleveland, O.

Welding, Autogenous.
Can. Blaugas Co., Ltd., Montreal.
L'Air Liquide Society, Toronto.

Welding, Acetylene and Oxygen.
Can. Blaugas Co., Ltd., Montreal.
L'Air Liquide Society, Toronto.
Metals Welding Co., Cleveland, O.

Welding Machines, Electric, etc
Can. Blaugas Co., Ltd., Montreal.
Tabor Mfg. Co., Philadelphia, Pa.

Wheels, Emery, Carborundum.
Can. Hart Wheels, Ltd., Hamilton, Ont.
Dom. Abrasive Wheel Co., Toronto.

Winches.
John H. Hall & Sons, Brantford.
Northern Crane Works, Walkerville.

Window Wire Guards.
Canada Wire & Iron Goods Co., Hamilton.

Wire Cloth and Perforated Metals.
Canada Wire & Iron Goods Co., Hamilton.
Dennis Wire & Iron Works Co., Ltd., London.

Wire Forming and Stamping Machinery.
Brown, Boggs Co., Ltd., Hamilton Canada.
F. B. Shuster Co., New Haven, Conn.
Baird Machine Co., Bridgeport, Conn.

Wire Guards and Railings.
Canada Wire & Iron Goods Co., Hamilton, Ont.

Wire Nails.
Parmenter & Bulloch Co., Gananoque.

Wire Nail Machinery.
National Machy. Co., Tiffin, Ohio.
A. R. Williams Machy. Co., Toronto.

Wire Straighteners and Cutters.
Baird Machine Co., Bridgeport, Conn.
Brown, Boggs Co., Ltd., Hamilton Canada.
F. B. Shuster Co., New Haven, Conn.

Wire Coiling and Pointing Machines.
Baird Machine Co., Bridgeport, Conn.
F. B. Shuster Co., New Haven, Conn.

Wood Boring Machines.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Girard Machine & Tool Co., Philadelphia, Pa.
Independent Pneumatic Tool Co. Chicago, Ill.

Woodworking Machinery.
Buffalo Forge Co., Buffalo, N.Y.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
New Britain Machine Co., New Britain, Conn.
Plessisville Foundry, Plessisville, Que.
A. R. Williams Machy. Co., Toronto.

Wrenches.
Armstrong Bros. Tool Co., Chicago, Ill.
Butterfield & Co., Rock Island, Que.
Canadian Billings & Spencer, Ltd., Welland.
Keystone Mfg. Co., Buffalo, N.Y.
Wells Bros. Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Wrenches, Automobile Narrow Jaw and Monkey.
Remis & Call Hardware & Tool Co Springfield, Mass.
Trimont Mfg. Co., Roxbury, Mass.

Wrenches, Pipe, Monkey.
Remis & Call Hardware & Tool Co Springfield, Mass.
Trimont Mfg. Co., Roxbury, Mass.

Wrenches, Ratchet and Basin.
Remis & Call Hardware & Tool Co. Springfield, Mass.
Keystone Mfg. Co., Buffalo, N.Y.
Trimont Mfg. Co., Roxbury, Mass.

No, Stevens' Stopper won't stop a train, but it will stop the blow hole in a defective casting so that you cannot find it.

In this way, it helps your bank account. The casting that otherwise would have to go to the scrap heap can be converted into good coin of the realm.

Same color as the rest of the casting. Doesn't look like a blue patch on Casey's faded overalls.

How to use Stevens' Stopper, or Circle Cement:

Stevens' Stopper is a fine powder, used with a little water and made into a paste—the hole is easily filled with a putty knife or trowel. It takes anywhere from two to twenty-four hours, depending upon the size of the patch, for the filler to become as hard as the casting itself. When rubbed with a file it shows the color of the casting, hence it is the best filler and the one thing that saves your castings, and that means the saving of your dollars.

Another thing—I do not ask a fancy price for it.

A pound will save many dollars' worth of castings. Put up in 5-lb., 10-lb., and 25-lb. cans.

FREDERIC B. STEVENS

Manufacturer of
Foundry Facings and Supplies, Buffing Compositions
and Platers' Supplies

Corner Larned and Third Sts. DETROIT, MICH.

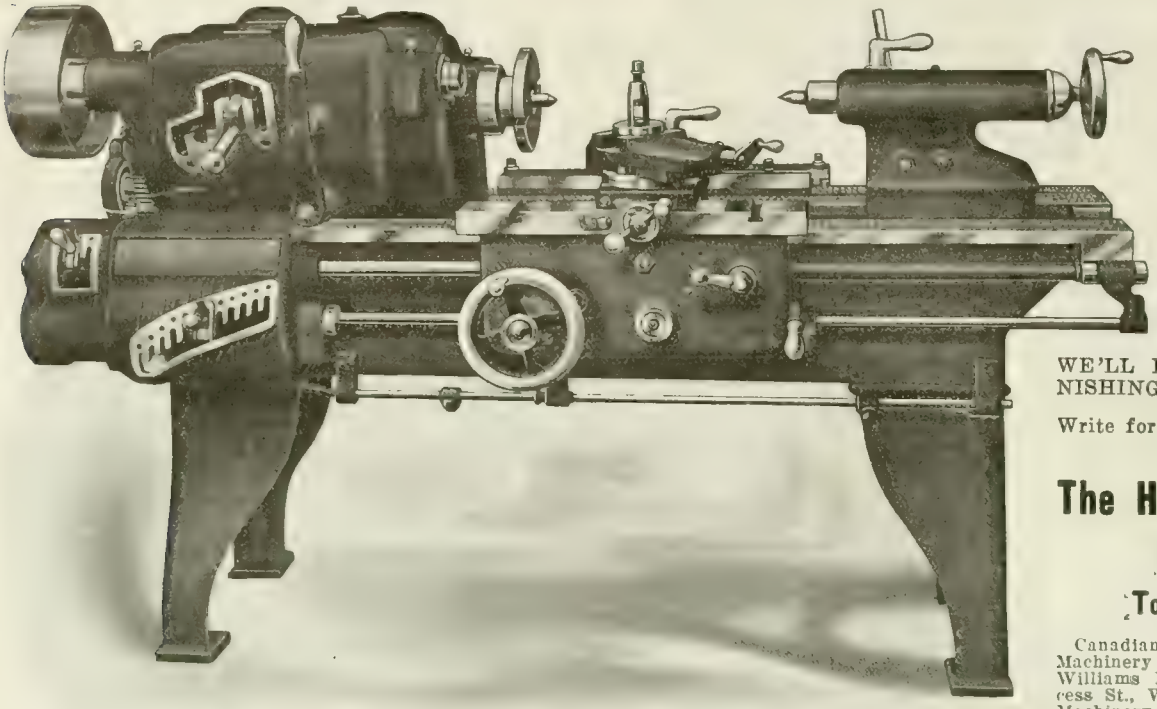
BRANCHES

WINDSOR, ONTARIO, 20 PITT STREET
INDIANAPOLIS, IND., 138-140 SOUTH DELAWARE STREET

STEEL CASTINGS
WE MANUFACTURE
Adamantine, Chrome, Manganese and Nickel Steel Castings
ANNEALED AND UNANNEALED
NONE TOO LARGE FOR US TO HANDLE.
MACHINE MOULDED GEARS
Any size up to 18 feet in diameter,
without the use of patterns
Hull Iron & Steel Foundries
LIMITED
Head Office and Works at HULL, P. Que.
Branch Office at Montreal, P. Que.
TRADE MARK

HENDEY 18-Inch GEARED HEAD LATHE

8 mechanical changes of speed for spindle with driving shaft running at constant speed, 4 direct and 4 through back gears.



36 DIFFERENT THREADS AND FEEDS are had through **Mounted Change Gearing**, each change being quickly made through controlling handles in Gear Boxes.

BEFORE PURCHASING A NEW LATHE INVESTIGATE THE HENDEY SERVICE.

WE'LL HELP YOU BY FURNISHING LIST OF USERS.

Write for descriptive circular.

The Hendey Machine Company

Torrington, Conn.

Canadian Agents: A. R. Williams Machinery Co., Toronto, Ont.; A. R. Williams Machinery Co., 260 Princess St., Winnipeg; A. R. Williams Machinery Co., Vancouver; A. R. Williams Machinery Co., St. John, N.B.; Williams & Wilson, Montreal.

ADVERTISING INDEX

Allen Mfg. Co. 37
Armstrong Bros. Tool Co. 37
Armstrong Mfg. Co. 37
Armstrong Whitworth of Canada Ltd. 47

Baird Machine Co. 38
Baker Bros. 49
Banfield & Sons, W. H. 36
Bertram, John & Sons Co. 1
Blake & Johnson 6

Can. Blaugas Co., Ltd. 8
Can. Economie Lubricant Co. 7
Can. Wire & Iron Goods Co. 38
Cramp & Sons Ship & Engine Building Co., Ltd. 33
Cook Co., Asa S. 53
Commercial Oil Co. 7
Cuffe-Quinn, W. T. 36
Cushman Chuck Co. 6

Darling Brothers 7
Dominion Sheet Metal Co. 6
Drury, H. A. Co., Ltd. .... Front Cover

Elmes Eng. Works, Charles F. 47

Fay & Scott 49

Garvin Machine Co. 38
Geometric Tool Co. 31

Girard Machine & Tool Co. 36
Gooley & Edlund, Inc. 49
Globe Machine & Stamping Co. 45
Gorton Machine Co., Geo. 34
Grant Mfg. & Machine Co. 40

Hamilton Gear & Machine Co. 38
Hamilton Motor Works 37
Hanna & Co., M. A. 53
Hendey Machine Co. 56
Hill, Clarke & Co., of Chicago 35
Hull Iron & Steel Foundries 55

Jenckes Machine Co. 47

Lackawanna Steel Co. 6
L'Air Liquide Society 45
Lane. Dynamo & Motor Co. 53
Landis Machine Co. 39
Lymburner, Ltd. 4

McDougall Co., R. ... Inside Back Cover
McLaren Belting Co., J. C. 38
Main Belting Co. 39
Manufacturers' Equipment Co. 43
Marion & Marion 36
Morton Mfg. Co. 36
Murchey Machine & Tool Co. 45
Marshall & Huschart Machy. Co. 40

New York Machinery Exchange ... 33
Nicholson File Co. 4

Northern Crane Works 53
Norton, A. O. 39
Norton Company 8
Oven Equipment & Mfg Co. 51

Parmenter & Bulloch Co., The 53
Perrin, Wm. R., Ltd. 43
Plessisville oundry 38
Positive Clutch & Pulley Works 39
Pratt & Whitney Co. Inside Front Cover
Puro Sanitary Drinking Fountain Co. 34

Ridout & Maybee 36
Root, C. J. Co. 38
Rumely-Wachs Mach. Co. 34

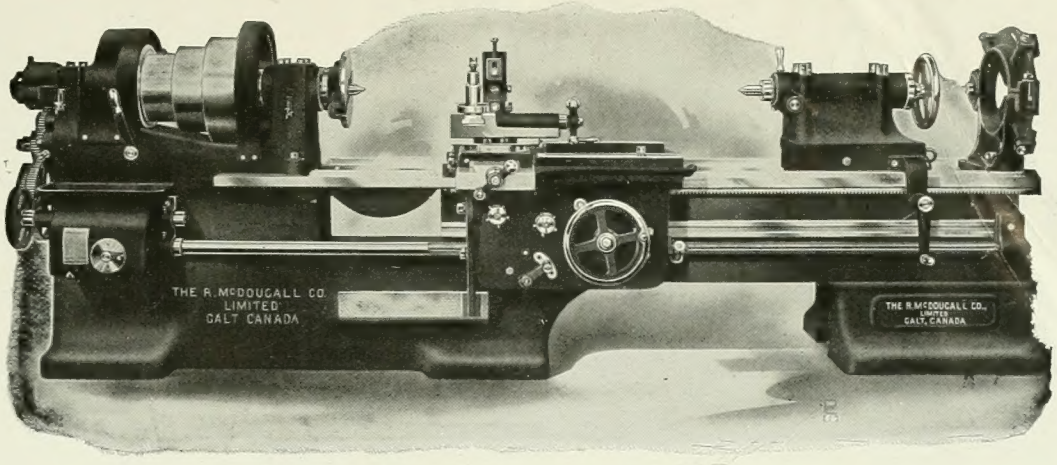
Shuster Co., F. B. 38
Smart Turner Machine Co. 37
Starrett Co., L. S... Outside Back Cover
Steel Bending Brake Works 37
Stevens, Frederic B. 55
Stow Mfg. Co. 4

Tabor Mfg. Co. 37
Tod, Wm., Co. 3
Toronto Testing Laboratory 39
Wells Bros. of Canada, Ltd. ..... Inside Back Cover
Whiting Foundry Equipment Co. 47
Williams Machinery Co., A. R. ... 31
Williams, J. H. & Co. 5

McDougall Gap Lathes

—

Strength
Accuracy
Quality



Take a look at the next money you intend to invest in a Lathe.
Then, take a look at the money's worth we offer you in our machine.
Your money will soon come back to you in increased production and we will have the pleasure of having a satisfied user. Our machines are just as good as they look and they look good too.
We invite the closest inspection.

ARE-MAC-DEE IS A GUARANTEE

Particulars on request.

The R. McDougall Company Limited

Manufacturers
GALT, Ont., Canada
The Canadian Fairbanks-Morse Co., Limited, Sales Agents.

Little Giant

CYLINDRICAL LIMIT GAGES

For shell work this style of gage is most efficient and economical.

PROMPT SHIPMENT.

We maintain a large stock at all times.

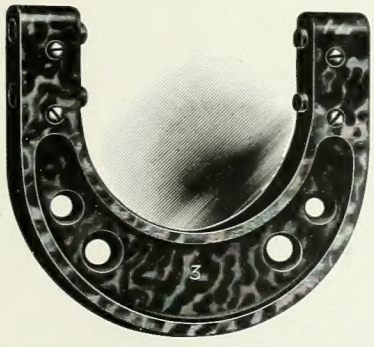
These can be shipped set to special limits specified by the customer within **48 hours** from receipt of order.

Gages set to special limits and with setting plugs can be shipped in 7 to 10 days.

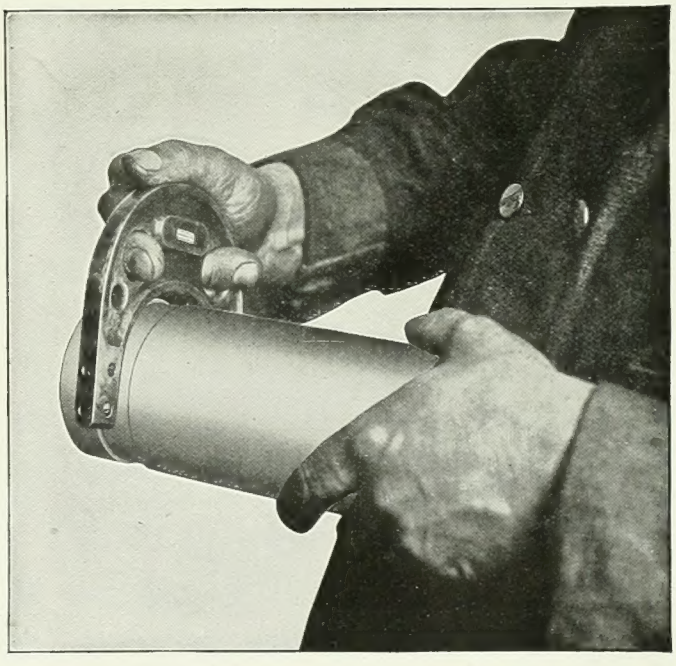
THREAD LIMIT GAGES.

For every form and style of screw thread.

Send for our Gage Catalog.



The upper points are set in maximum limits — the lower points to minimum limits. Points can be sealed to prevent tampering.

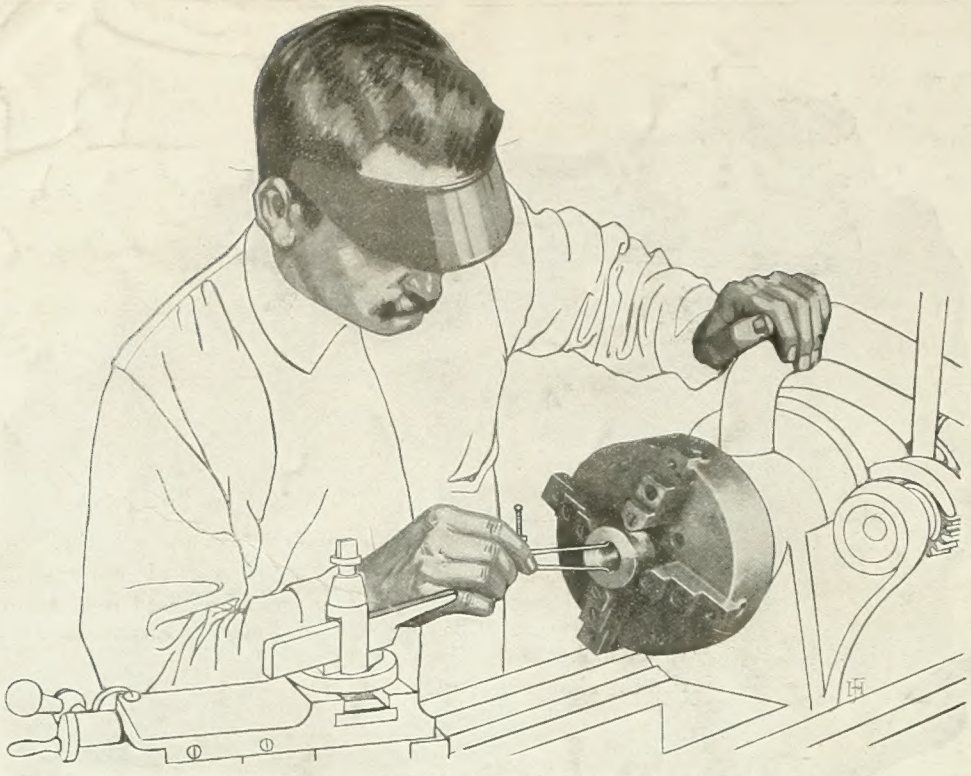


Wells Brothers Company of Canada, Limited

GALT, ONT.

Sales Agents:
The Canadian Fairbanks-Morse Co., Ltd., Montreal, Toronto, Vancouver, Winnipeg, St. John, Calgary.

BY INVITATION
MEMBER OF



Starrett Calipers

Variety of Styles

Practically every job of the machinist requires calipers of some kind for laying out or measuring the work. The Starrett line of calipers includes a number of styles and sizes to suit the general needs of machinists as well as special styles for particular operations. The line includes toolmakers' spring calipers, Fay and Yankee calipers, firm joint calipers, lock joint transfer calipers, Hermaphrodite calipers, etc.

Toolmakers' Calipers

For the use of toolmakers and machinists who work on delicate operations requiring sensitive measurements, we make a line of light round leg toolmakers' calipers of great stiffness and strength which are perfect for delicate work. Sizes and prices as follows: (includes both inside and outside styles) 2″—$1.00, 3″—$1.25, 4″—$1.50, 5″—$1.50, and 6″—$1.75.

Send for Free Catalog

Our free catalog No. 203, sent free on request, gives styles and prices of 2100 styles and sizes of fine tools and hack saws. Send for it.

The L. S. Starrett Co., Athol, Mass.
World's Greatest Toolmakers
New York London Chicago 42-456

Starrett Tools
The Standard Instruments of Precision

The advertiser would like to know where you saw his advertisement—tell him.